# THE ELECTRICAL REVIEW

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# THE IMMISCH MOTOR.

THERE is no doubt that Mr. Immisch has acted with great wisdom and prudence in refraining from bringing his electro-motors prominently before the electrical world until he was fully satisfied as to their ability to perform their functions satisfactorily. Many a promising invention has been injured by a too hasty plunge into the cold waters of practical application, when a little unpreparedness, or a failure arising from some trivial but unforeseen circumstance, has often been the means of unjustly discrediting it, and perhaps altogether preventing its adoption.

From a description which we publish on another page, it will be seen that the Immisch motor has been modified during the past year or two, until some objectionable features which it possessed at the time of the Inventions Exhibition have, in the opinion of its inventor, been removed. We hope these motors may be able to endure the struggle for their existence, and may prove their fitness by their survival. We venture to think, however, that in that struggle they will be still further modified, and will probably eventually settle down into some simple form of the drum-armature type, with collectors of the Gramme pattern. It may be said even now that they differ in no respect except in their method of connection and commutation from the above-named type; and this is an additional proof, to the many which have been afforded in the process of settling down of types during the last few years, of the wisdom of those who have found that variations from certain simple and well-defined forms were seldom productive of substantial benefit.

In form the armature is of the drum type, and like most other drum armatures is composed of a number of thin discs or washers strung on the shaft, and insulated from one another. At the ends of the drum, and for a short distance also in the middle, the discs are provided with Pacinotti teeth or projections, which are no doubt useful as guides in winding, and as supports for the coils when wound.

Unless we are mistaken, the motor shown at the Inventions Exhibition was provided with teeth along its whole length. We suppose it has been found that they could be dispensed with without loss. Whether there is any real advantage in the use of such projections from an electrical or magnetic point of view may be doubted. The question has from time to time been the subject of discussion amongst electricians, in our columns and elsewhere, without any final or conclusive decision being arrived at. There is no doubt that, as such projections may be brought very near to the pole pieces, the magnetic resistance of the air space may, under some circumstances, be thereby reduced, and this is an advantage. But if the main body of the armature core is to be worked at a high degree of saturation, as is desirable, it follows that these projections should be very large, or they will be themselves saturated long before the mass from which they spring, thus leaving those lines of force which they cannot convey to find their way into the core by the rather deep and highly resisting paths through the depressions in which the winding is placed. To meet this difficulty, then, the projections, to be really useful, should offer a considerable surface to the poles and have a large total section. But if this is done the space left for the wire becomes unduly limited, and relief can only be sought by increasing the current density, which is objectionable on more grounds than one; or by increasing the size of the armature, which means increased cost. A further objection to these teeth is that they favour the formation of moving tufts of lines of force which may cause loss of energy by Foucault currents, but this loss can be greatly reduced or perhaps practically eliminated by making the number of projections considerable, and thereby subdividing the tufts until a smooth and even action, without jerks or pulsations, is obtained. Another consideration in connection with these Pacinotti projections may be brought forward, as it to some extent springs from the objection last alluded to, viz., that they give rise to buzzing, or pulsating sounds, during rotation. The noise is no doubt partly the result of magnetic and electrical jerks which set the whole machine in vibration. This action would probably affect the bearings, but for the fact that the effects on any two diametrically opposite portions of the armature balance and neutralise one another. These pulsations are mainly a succession of magnetic and electrical attractions, but added to these there is the molecular "Joule effect," of alternate elongations and retractions of the iron. This latter is probably not a serious matter. Added again to these is the ordinary pulsation or beating of the air—a purely mechanical cause of sound. The remedies for this state of things, where it is found to exist, are simple, viz., a large number of projections, a sloping away of the inside faces of the pole pieces at the edges, and a smooth surface of the armature as a whole, together with a transverse or slightly spiral arrangement of the projections. The latter would cause the coils to occupy when at the neutral regions, planes cutting those regions, but even if the opposite ends or portions of the coils were in active parts of the field they would have no current produced in them, as they would be the seat of equal and opposite electromotive forces.

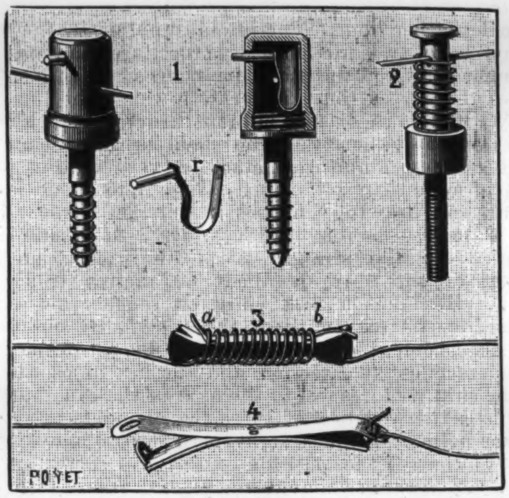
If, however, a smooth armature core is used, the actions alluded to disappear for the most part, and the question resolves itself merely into one of magnetic resistance. Probably it will be found in practice that the utilisation of the whole of the armature surface for placing the wire will so reduce the depth of air-space that the magnetic resistance will, taking all the circumstances into consideration, not be sensibly greater than when projections are used. The matter is one which appears capable of a ready solution by calculation; but if the magnetic and electrical conditions are not either strongly in favour of, or opposed to, the use of projections or teeth, there is little doubt that the presence of such teeth affords a ready and secure means of supporting and holding the coils in place, an advantage which is by no means to be overlooked now that magnetic fields have become so strong that the tendency to displace coils or individual wires, perhaps rendered slack by expansion from centrifugal force and heat, is very considerable.

So much, then, for the form of armature which Mr. Immisch has adopted, no doubt after full and careful consideration, and in accordance with the practice most in favour with experienced constructors. The form of field magnet employed presents no novel feature. It is the well-known form with a double magnetic circuit, which has been for so long used by Gramme, Siemens and others, but which has lately to some extent been abandoned in favour of the single circuit or "horse-shoe." It is interesting to note that in the earlier forms of this motor a peculiar cutting away of the pole pieces was adopted at the sides from which the armature was retreating. This was for the purpose of preventing a backward pull exerted by the pole pieces upon the Pacinotti projections. Such an action could only have resulted from the use of an unsuitable field and a small number of projections, and we are glad to see that the ordinary or normal type of pole piece has, with proper excitation, been found the best, especially as the construction alluded to would incapacitate a motor from running in either direction, or at least would cause it to give unequal effects in the two directions. The manner of connection of the coils of the armature and the construction of the commutator is unusual. It originally bore some resemblance to the Brush and Thomson-Houston forms, and was rather intricate, having, in the motor shown at the Inventions Exhibition, the peculiarity that the most useful coil was cut out of circuit as well as the idle coil. This was certainly a feature which Mr. Immisch has done well to leave behind him, together with his former disbelief in the existence of a counter E.M.F. in motors, which was once the occasion of a somewhat heated correspondence in our columns. The arrangement of the commutator has undergone some modification in the latest forms, the coils in the neutral region of the field being now short circuited, and not open circuited, and the whole of the other coils being retained in operation. As the number of armature coils is considerable, it will be seen that this arrangement gives practically the effect of an ordinary or Gramme "collector," and, as we said at the outset, we imagine that eventually this special commutator will disappear, and the well proved and simpler "collector" will take its place.

**Street Lighting in France.**—Street lighting by electricity, *Industries* states, is rapidly growing in favour in France. Six important towns have now adopted the system, Saint-Etienne, Tours, Dijon, Bellegarde, La Roche, and Bourganeuf.

## TERMINALS AND WIRE-HOLDERS FOR RAPID CONNECTIONS.

EVERY amateur who has made experiments with ordinary currents of low intensity knows how inconvenient the ordinary terminals and wire-holders are, and what loss of time and patience they involve. It is to avoid these inconveniences that M. Binkowski has invented the improved apparatus shown in the figure, which we reproduce from *La Nature*. No. 1 shows an ordinary terminal without any screw for tightening the wire. Inside this terminal there is a cavity in which is placed a little spring terminated by a brass rod protruding through the terminal. By pressing upon the end of this, introducing the wire into the hole, and then letting go, the wire is held fast and gives an excellent electrical contact, thanks to the spring which presses it against the hole of the terminal. The construction of the spring is shown at *r*. No. 2 is a similar terminal and a still simpler one, in which the pressure is exerted by a spiral spring which merely has to be lowered in order to open the hole into which the wire is introduced. The spring exerts the pressure required to ensure good contact. Nos. 3 and 4 show wire-holders intended to connect the extremities of two wires.



No. 3 is a double reproduction of the idea shown in No. 2. The spring is pressed first in one direction, and then in the other to catch the two wires successively into the two holes, *a*, *b*, made in the holder, and the connection is thus established.

No. 4, on the contrary, bears more resemblance in its construction to the first terminal. A brass plate slightly curved is bent back at its two extremities and a hole is made in each bend. A spring fixed to the centre of the plate has also a hole at each extremity. By pressing upon this spring and catching the wire into the hole in the bend, the spring is kept stretched and the wire held against the plate.

## THE ELECTRIC LIGHTING OF SHIPS FOR NAVIGATING THE SUEZ CANAL BY NIGHT.

THE traffic on the Suez Canal having greatly increased during the past four years, notwithstanding the depression of trade, the company has, among other methods of affording increased facilities, studied the transit by night. As these proved successful permission was granted about the end of 1885 for vessels to navigate the canal by night on certain conditions: "From December 1st, 1885, and until further notice, ships of war and mail boats may be authorised to pass along the canal by night between Port Said and kilometre 54 (29½ miles) on the same conditions by adopting the following regulations :—

"Ships of war and mail-packets which intend to pass from Port Said to the 54th kilometre by night or *vice versâ*, must inform the agents of the company at Port Said, Ismailia or Port Tewfik that they are furnished with the following fittings :

"At the prow, an electric projector of the range of 1,200 metres ;

"At the stern, an electric lamp capable of illuminating a circular space of 200 to 300 metres diameter.

"On each side, an electric lamp with a reflector."

In the course of April last several vessels passed with complete success from Port Said to Ismailia, proceeding in 16 to 18 hours from sea to sea and thus saving a mean time of 18 to 20 hours.

Almost the only difficulty in passing the canal is to keep the vessel in the axis of the cutting, allowing it only very slight deviations around the axial line. This requires some care since the bottom width is only 22 metres and the maximum speed allowed is only 10 kilometres per hour. The pilots, supplied by the company, have two methods of procedure, the one for straight parts and the other for curves. A ship which takes the direct route never follows a right line, but only a line more or less sinuous around such a right line, and the difficulty in the canal is that the amplitude of these sinuosities must be very trifling for a ship of more than 100 metres long, 12 to 13 metres in width and drawing 8 metres of water in a water-way of 22 metres bottom width and 8·7 to 9 metres in depth. In the straight parts the pilot, on the bridge of the ship, is about 60 metres from the prow. He takes a first point on the horizon and a second at the extremity of the prow. By observing the displacement of the second with respect to the first, he appreciates the direction and the rate of oscillation of the ship with respect to the axis of the canal and he regulates the variation of these two elements by means of the helm. In the straight portions the buoys serve also to control the position of the ship if any exceptional circumstance should remove it notably from the axial direction. In the curves the manner of direction is a little different and judgment plays here a preponderating part ; the buoys are nearer to the banks, and the curved axis of the canal can only be determined by the exercise of judgment.

In the night the pilot must supply himself with the necessary indications. There are no special difficulties at the entrance of a cutting during the night ; it is sufficient to illuminate the buoys to render them luminous, causing those on the larboard side to carry a red light and those on the starboard a green light. The method for this purpose is the use of Pintock's compressed gas. For the straight parts pilots are furnished with points on the horizon by arranging in front of each station (*i.e.*, at distances of 5—6 miles) directing lights, white and visible to the north and the south of the station at distances of 7—8 miles. In this manner the ship, when arriving within a mile of the nearest light, sigbts also the next light and takes its direction accordingly. Thus the visual ray of the observer sighting the directing light on the horizon always makes with the axis of the canal an angle so small that there is no inconvenience in confounding these two directions.

The perspective effect is obtained in the night by fitting the prow of the vessel with an electric light projector of suitable power and divergence so as to render visible the banks and a sufficient number of buoys, three or four pairs, or a range of 1,200 metres.

Finally, the accidental control of the passage of the ship is obtained by igniting at the required moment on each side and at the stern, lights so powerful that the pilot may see the buoys on the larboard and starboard and at the same time the works behind.

In the curves the directing lights are not available, and the curvature of the canal is rendered visible ahead by the illumination of the buoys and the banks by means of the electric light projector, and astern by means of the side and stern lights. The projector is necessary also to show that the way is clear. This system is completed by luminous signals which transmit orders and indications to vessels on their way. The fixed directing lights are all arranged to receive these coloured luminous signals. The fixed portion of these arrangements has been established by the company. The electric lights are carried by each ship.

The Pintock gas buoys are ordinary buoys charged with compressed coal gas and surmounted by a Fresnel's optical apparatus in which the gas is burned. An automatic releasing apparatus regulates the transit from the high pressure necessary for storing the gas to the low pressure required for its combustion. These lights are white, coloured green or red by coloured glasses.

The station lights consist of a white directing light carrying from 9 to 10 miles, and a play of red lights, the number and position of which give the signals to be transmitted to ships. All these lights are raised from 10 to 11 metres above the level of the canal.

The apparatus for electric lighting is composed of, at the prow a projector having a range of 1,200 metres ; at the stern, an electric lamp capable of illuminating a circular field of 200—300 metres in diameter ; on each side an electric lamp with a reflector ; a dynamo to produce the necessary electricity worked directly by a special steam engine and the necessary arrangement of cables and commutators which effect the distribution.

Most mail packets and ships of war are provided either with projectors or with an internal arrangement for electric lighting by incandescence ; these appliances can be easily adapted for the passage of the canal. In order to give a more complete idea of the necessary plant, we will describe that which is arranged exclusively for the passage of the canal, independently of any other use, and we will take as an instance that which MM. Sautter, Lemmonier & Co. have supplied to the Peninsular and Oriental Company for their present use. This company has fixed its choice upon movable apparatus, which the vessel takes on board on arriving at Port Said or Suez, and puts on shore before leaving Suez or Port Said.

*The Dynamo and its Motor.*—The Dynamo is on the Gramme system with compound wrapping, and it can produce at the tension of 70 volts a current exceeding 75 ampères ; 45 for the prow-projector, 8 for each side-light ; that is to say, 16, and 14 for the stern-light.

The engine, on Brotherhood's system, drives the dynamo directly ; both the machines are fixed upon a light but rigid support of double T iron, fitted with suspension rings for embarking and disembarking, the metallic trellice work which further protects the machinery. The piping is arranged to fit that which conveys steam to the auxiliary cranes generally placed at the bows. The whole movable installation can supply 125 to 150 10-candle incandescence lamps.

*Distribution of the Electricity.* — The distribution is effected in four derivations, each one serving for one of the light-foci. The cables which connect the dynamo to each of the projectorsare of a section calculated so that each focus receives the necessary quantity of electricity. They are coiled upon drums, and these are inclosed in a chest which is placed on board with the motors.

A distribution table commands all this apparatus ; it is fixed upon the bridge within reach of the pilot. He is in constant communication, by means of a Colson telephonic apparatus, with the man who works the projector at the prow, and by pressing upon the commutators marked "starboard," "larboard," or "stern," he can kindle or extinguish any of these lights at pleasure.

*Projector at the Prow.* — The projector throwing the light ahead has an aplanetic mirror 0·40 metre in diameter, on Mangin's system. In front of the apparatus an opening with plano-cylindric lenses gives the requisite and suitable divergence to the beam of light.

Before finally selecting this optical apparatus, which has been much improved, and which is employed in the navies of France, England, Italy, Austria and Russia, numerous trials have been made with reflectors less powerful and less exact, which have proved their inefficiency. On account of the capital importance of the part played by this projector at the prow, there is a risk of very serious accidents if a ship is not sufficiently equipped in this respect.

The projector should be fixed at the height of three metres above the water-level upon a movable flooring. Upon this flooring is posted the man whose duty it is to approximate the carbons of the voltaic arc and to modify the direction of the beam of light from time to time, according to the orders of the pilot on the bridge. Hence it is necessary that the latter should be able to transmit his orders telephonically. The telephone most suitable for this purpose is that of Captain Colson, which has been already officially adopted in the French army.

*Stern Light.*—This light is intended only to illuminate the concave bank of the canal, or the line of buoys in the curves, so as to keep the pilot acquainted with the position of the stern of the vessel. For this purpose it is sufficient if it carries from 150 to 200 metres. It is obtained with an electric lamp enclosed in a metallic lantern, bearing an optical arrangement giving the divergence suitable. The whole is suspended at the height of about three metres above the water. A suitable arrangement, peculiar to each vessel, enables the lamp to be turned from the bridge in the direction required.

*Side Lights.*—The arrangement is analogous to that at the stern. These lights, placed about the middle of the ship a little in front of the bridge, serve the ships which are passed at the stations when crossing. They are composed of a similar automatic lamp, placed at the focus of an optical arrangement, as at the stern. The method of attachment depends on the special arrangements of the ship.

It is easy to understand from this brief description of a movable plant the simple modifications which must be made in any permanent electric installation pre-existing in any vessel so as to adapt it to the passage through the canal.

We now give an extract from the report of the first passage by night, executed by the *Carthage*, of the Peninsular and Oriental Company, according to the account which the captain commanding this fine vessel has addressed to his company. This report shows that the problem is definitely solved, and that thanks to the progress of electric lighting and the improvements introduced into the apparatus, the passage of the Suez Canal by night no longer presents anything dangerous or hazardous.

"I have the honour of announcing to you our arrival at Suez this day at 2.21, coming from Port Said.

"The passage from Port Said to the southern entrance of the canal took 18 hours. If we deduct two hours of delay occasioned, one hour by a dredging vessel which did not show the regulation lights and one hour for the stations, we obtain an actual duration of 16 hours and consequently a mean speed of 5·43 miles per hour.

"The passage up to Ismailia presents all the interest of the first trial made by a large ship to pass the canal by night with the aid of the electric light.

"On our arrival at Port Said we found that all preparations for our entrance into the canal had been made by the company. The canal was open as far as Ismailia, and we were in a position to set off at 8 p.m. accompanied by those persons who took a great interest in the trial. The projector was fixed on a platform at the prow.

"At ten minutes to eight the machine was set in action, the conductors established and the circuits closed. Everything appeared in order and each light had the desired intensity. The dynamo acted until 8 p.m. before quitting the moorage buoys. On lighting the projector we could perceive that its position was well chosen, and that the power of the light and the amplitude of the illuminated arc were sufficient to foretell the success of the experiment. The number of lights around us and the presence before us of a steamer loading coal by torch light hindered us from seeing the buoys placed at the entrance to the canal.

"At 8 p.m. the mooring ropes were detached, and as soon as we had passed the steamer lighted up with torches we perceived distinctly the buoys at the entrance. The entrance to the canal, as you know, is by a curve, so that I feared to encounter here a first difficulty if we missed the buoys at the entrance. The agents of the company, doubtless foreseeing this difficulty, had prudently lighted up the two first buoys, but I am of opinion that even without this precaution the light of the projector would have been sufficient, and, in fact, it enabled us to see the buoys.

"The moon was not yet risen, and showed herself only at 9 p.m., so that we had for the first part of the experiment an hour of normal darkness.

"We had no difficulty in entering the canal, and when once away from the influence of the lights of the town and the port we saw distinctly in the curve on each side of the canal two buoys ahead of us, and less distinctly a third.

"But it was when we reached the straight part that the entire efficacy of the projector became manifest. The diverging aperture gave to the beam of light a sufficient amplitude to illuminate a buoy on each side at some feet in advance of the prow. Further off the rays fell upon the banks and illuminated them at the same time as the buoys. We saw distinctly two on each side, that is to say, three including the buoy which the vessel was approaching; a fourth buoy was sufficiently visible to judge of its position. The range was thus three-tenths of a mile, *i.e.*, amply sufficient to manœuvre the vessel. The banks, being of a light colour, reflected the light into the canal, thus increasing the intensity of the illumination; their influence was especially sensible by reason of the height of the banks in the curves on approaching Ismailia. Nothing could exceed the illumination which we had everywhere in the curves, and which was very perceptibly due to the reflecting power of the banks of white sand.

"We reached Ismailia at 5.15 a.m. We experienced no difficulty in the management of the ship during the passage, and only one stoppage in the curve, two miles before reaching Ismailia. A dredging boat on the western bank had neglected to kindle the regulation lights, and the pilot had in consequence to stop the ship. On resuming our forward movement, although we had successfully passed the dredge, the ship could not get up sufficient speed to enter the curve. We had to stop and reverse the engines; finding ourselves then askew in the canal we had to return a certain distance to get right. The delay occasioned amounted to an hour, which, if deducted from the time spent since setting out from Port Said, gives a mean speed of 5·09 miles per hour.

"The success which we have obtained is most encouraging, and we may consider the possibility of the passage of a large ship by night with the aid of the electric light an established fact.

"The directing lights arranged upon the eastern bank opposite each station are good, and in the straight parts we can steer in the middle of the canal between the buoys by keeping them well ahead; several times the projector was extinguished, and during periods varying from half an hour to an hour we steered simply by the directing lights.

"I must add that the circumstances under which the trial was made were all in favour of success; the atmosphere was transparent, there was moonlight during the greater part of the night, and there was no wind. Still, in my opinion, the moonlight does not diminish the value of the success. We must, indeed, remember that we experienced no difficulty during the first hour of darkness which we had, and, indeed, the buoys were better illuminated before than after the rising of the moon. In curves of a low radius the buoys were more distinct with the electric light than with the moonlight.

"I will conclude by offering you my congratulations on the success of our experiment, and the increased facility which it offers for the acceleration of our postal service in future.

"Signed, G. H. Hector, Commander."

This report is conclusive. The experiments in navigation between Port Said and the 54th kilometre, or we may rather say Ismailia, having proved successful, it is certain that the great bitter lakes may be reached with the same facility, and it appears probable that with favourable tides we may go on to Suez.

This progress does not realise the doubling of the power of the canal; but for mail packets and ships of war, that is to say, for 22 per cent. of the vessels passing through, it shows the possibility of passing the canal in a single day.

The Canal Company, which has taken the initiative in these trials of a transit by night, by its studies and its fixed installations will complete them, doubtless, when the time has come; but meantime it depends only on shipowners to follow the example set by the Peninsular and Oriental Company, and to pass from sea to sea in 18 hours.—*Génie Civil.*

## ON THE EXPERIMENTS COMMUNICATED BY M. FONTAINE ON THE TRANSMISSION OF POWER.*

By M. MARCEL DEPREZ.

M. Fontaine has lately submitted to the Academy an experiment on the transmission of power by electricity, by means of a process which he considers novel, and which consists in substituting for the generating and the recipient machines a collection of machines connected in series, and in such a number that the sum of their electromotive forces makes up the value which it is desired to obtain. In the experiment in question the number of generators was four, and the number of the recipients three. This idea is far from novel, and it has been proposed by all the electricians who have sought to obtain high tensions without having recourse to the construction of the special machines which I have been the first to realise.

As for the method employed by M. Fontaine to govern simultaneously the four rings of the generators, it much resembles that described in a patent which I took out on April 28th, 1885, in which I gave precisely an example of the application of this procedure to a machine with four rings of 0·30 metre in diameter and 0·20 metre in length like those of the machine which served for the experiments in the works of the Northern of France Railway in February, 1883. There was thus produced an apparatus, each ring of which could give a force of 1,500 volts at 1,000 turns per minute, the internal resistance of a ring being 5·5 ohms, and the total resistance of the four inducers being 15 ohms. The weight of the acting parts was composed of:

| | | |
|---|---|---|
| Soft iron | ... ... ... | 1,124 kilos. |
| Copper | ... ... ... | 652 „ |
| Total | ... | 1,776 |

On adding 600 kilos for the support, it will be seen that we had arrived at a total weight below 2,500 kilos for a machine with four rings capable of producing 6,000 volts and 10 ampères at the speed of 1,000 turns per minute. This is half the weight of M. Fontaine's four machines. These results admit of no doubt, since they are obtained by the addition of the effects of identical machines perfectly known.

But this project was not continued, because the conditions laid down for the experiments at Creil were quite different. The machines of M. Fontaine revolved at the speed of 1,300 turns per minute, those at Creil made only 500 turns in the same time. The linear speed of the rings of M. Fontaine is 20·5 metres per second as against 7·5 metres for those at Creil. If I had given the latter a linear speed of 20·5 metres, they would have yielded an electromotive force exceeding 16,000 volts. The conditions are in no manner comparable, as it will be seen, and if the Creil machines are heavy it is simply because only a very low speed is required of them, and nothing has been done to lighten them. If in the arts we were to compare machines among themselves, taking lightness as the main condition, the engines of torpedo boats would be far superior to those in factories, and yet the use of the latter is far more general, though they are much heavier per unit of power. The reasons for this preference are too evident to require explaining.

In this order of ideas M. Fontaine's expedient is the same as that of the manager of a factory, who instead of a single engine of 100 horse-power, moving slowly and surely, should prefer to employ four small engines of 25 horse-power each, moving at a very high speed, and acting upon the same shaft by means of mechanical transmission, having for their object the reduction of the speed.

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* See Electrical Review for last week.

## THE IMMISCH MOTOR.

We have received from Mr. Albion T. Snell, the electrician to Mr. Immisch, a few particulars respecting the construction of the electro-motor, to which we alluded in our last issue. We have commented upon the apparatus somewhat freely in our other columns, and we shall therefore now deal only with the technical details of the motor, which appears to possess features likely to bring it into considerable favour. Fig. 1 shows a view of a 6 H.P. motor, the coiling of the

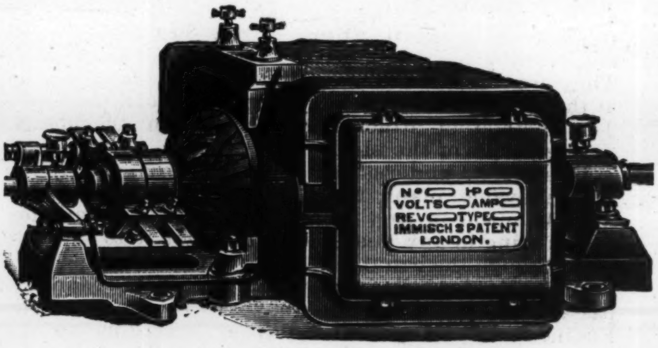

Fig. 1.

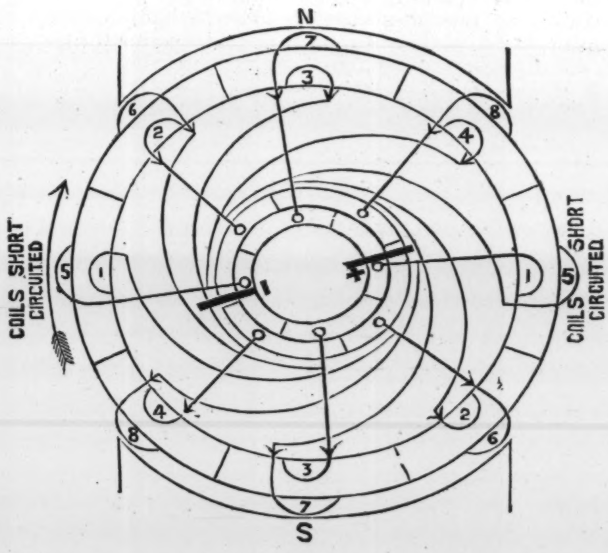

Fig. 2.

armature is shown diagrammatically in fig. 2, and the commutator in fig. 3. In the diagram only eight coils are indicated, although 48, 96, or more may be employed. The commutator is of the bisected type, and the coils are joined to two adjacent segments of the commutator on the two rings, of which one has an angular advance equal to one-half the width of the commutator bar. The two brushes side by side upon the two rings are connected together, so that only one pair is shown in the figure. Starting from one ring of the commutator under the brush, say with the coil marked 1, we cross to the other side of the armature, and join the connection leading to coil 6; but if we follow this line backward to the commutator we arrive at a segment under the same brush from which we started. Similarly, coil 5 connects with coil 2, and is short-circuited in the same way by the other brush. It will be observed that the magnetic axis of the armature itself would be situated underneath the coils which are short-circuited. The remaining connections are easy to follow; the two halves of the circuit can be traced through coils 6, 3, and 4 in series upon the one side, and coils 8, 7, 2 in series upon the other. It is to be observed, however, that this arrangement only amounts to the same as having an armature of normal type with a brush of wide face, so that its contact with two adjacent commutator bars is considerably prolonged.

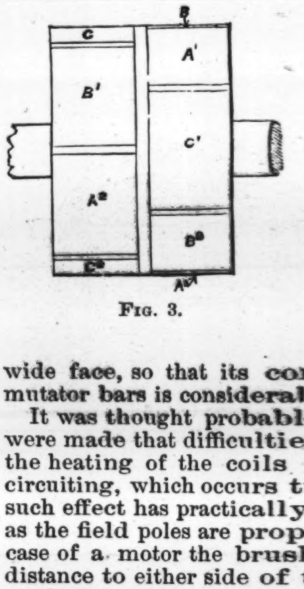

FIG. 3.

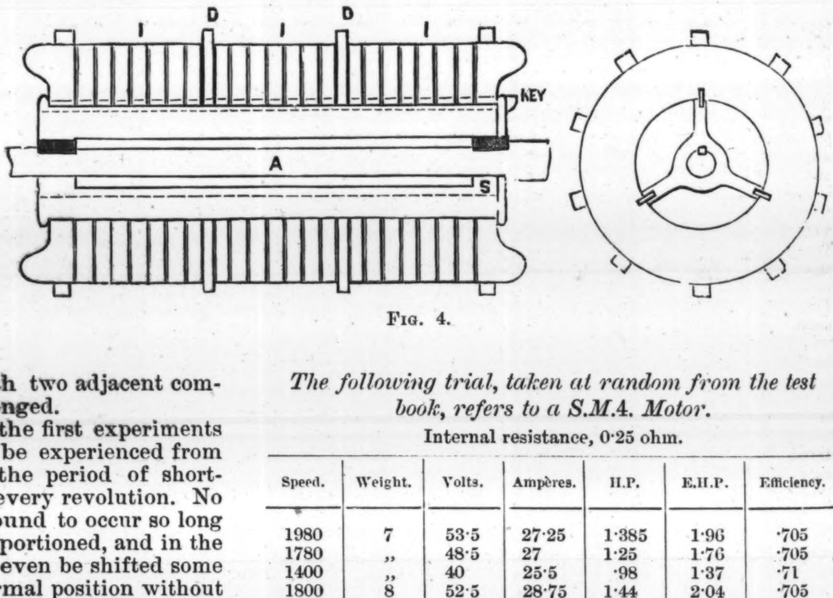

FIG. 4.

It was thought probable when the first experiments were made that difficulties might be experienced from the heating of the coils during the period of short-circuiting, which occurs twice in every revolution. No such effect has practically been found to occur so long as the field poles are properly proportioned, and in the case of a motor the brushes may even be shifted some distance to either side of their normal position without producing either sparking or any perceptible increase of heating. But, curiously enough, this does not apply to a dynamo of similar construction, the position of the brushes having to be adjusted with some care. So long as this is attended to the machine runs with perfect smoothness; but as soon as the brushes are displaced, although little or no sparking taking place, yet considerable and rapid heating is the result. It is claimed, however, that this is of little practical importance, for when the position of the brushes has once been determined they can be rigidly fixed, and the dynamo requires no further adjustment whether running on open circuit or with full load. It is said that the non-heating of the coil proves that during this part of the revolution the algebraical sum of the number of lines of force passing through it is constant. Mr. Albion T. Snell thus explains the discrepancy between the action of dynamos and motors in this respect upon the supposition that the angular distance upon the armature core over which no lines of force either enter or leave the iron is greater in the case of a motor than in that of a dynamo of similar construction.

Fig. 4 is a sketch showing the armature in section. S is a sleeve keyed or feathered on the axle, A; I, I, are the iron discs or washers insulated from each other, of which the armature is built up; and, D, D, are larger discs with projecting teeth as in the Pacinotti ring which serve as guides in coiling the wires or, as Mr. Snell prefers to call them, driving horns. We may here mention that an armature coiled in the Immisch manner and then in the method devised by Siemens gave, under similar conditions, results in favour of the former, the efficiency being somewhat higher and the sparking less.

Mr. Snell has also experienced similar effects with the Immisch apparatus to those observed by Mr. Esson and chronicled in our last issue.

The motor can be run in either direction by simply reversing the connections of either field magnet or armature connections, but this feature is common to the Reckenzaun and Elwell-Parker types also.

We have given a somewhat brief outline of the Immisch motor—the same maker's dynamo having a precisely similar armature—but in a future issue we may have occasion to refer to it again, for there are several features of interest in the application of these motors to tramway purposes which we hope shortly to describe, a 40 H.P. machine now being in course of construction for electric locomotion. We append a table of tests with which we have been favoured, showing the excellent results obtained in a trial of two motors.

*The following trial, taken at random from the test book, refers to a S.M.4. Motor.*

Internal resistance, 0·25 ohm.

| Speed. | Weight. | Volts. | Ampères. | H.P. | E.H.P. | Efficiency. |
|---|---|---|---|---|---|---|
| 1980 | 7 | 53·5 | 27·25 | 1·385 | 1·96 | ·705 |
| 1780 | ,, | 48·5 | 27 | 1·25 | 1·76 | ·705 |
| 1400 | ,, | 40 | 25·5 | ·98 | 1·37 | ·71 |
| 1800 | 8 | 52·5 | 28·75 | 1·44 | 2·04 | ·705 |
| 2200 | ,, | 63 | 29·5 | 1·76 | 2·48 | ,, |
| 1450 | ,, | 42·5 | 28·5 | 1·16 | 1·62 | ·715 |
| 1740 | ,, | 51 | 28·5 | 1·4 | 1·95 | ·72 |
| 1900 | ,, | 54 | 29 | 1·52 | 2·1 | ·72 |

Average efficiency, 71 per cent.

*Test of a S.M.6. Motor.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 920 | 12 | 130 | 31·25 | 4·42 | 5·45 | ·81 |
| 980 | 12 | 134 | 31·5 | 4·7 | 5·68 | ·83 |
| 1080 | ,, | 147 | 31 | 5·2 | 6·1 | ·85 |
| 1080 | ,, | 147·5 | 31·5 | 5·2 | 6·2 | ·835 |
| 960 | ,, | 137 | 31 | 4·6 | 5·7 | ·805 |
| 999 | ,, | 131 | 31·5 | 4·8 | 5·55 | ·865 |
| 1080 | ,, | 148 | 31 | 5·2 | 6·15 | ·845 |
| 1090 | ,, | 152 | 31·5 | 5·25 | 6·4 | ·82 |

Average efficiency, 85 per cent.

**Electric Railway in Mödling-Hinterbrühl.**—This line, which serves as the fashionable summer resort of the Viennese people, has the heaviest traffic in the holiday season, that is, the month of August. This year, *Industries* states, there have been conveyed, during August, 42,000 passengers, the total receipts being 10,800 florins (about £870.) From January to August the total number of passengers was 275,000, and the total receipts 41,284 florins (about £3,300.)

# DYNAMO-ELECTRIC MACHINERY.[*]

By J. HOPKINSON, M.A., D.Sc., F.R.S., and E. HOPKINSON, M.A., D.Sc.

### *Theoretical Construction of Characteristic Curve.*

Omitting the inductive effects of the current in the armature itself, all the properties of a dynamo machine are most conveniently deduced from a statement of the relation between the magnetic field and the magnetising force required to produce that field, or, which comes to the same thing but more frequently used in practice, the relation between the electromotive force of the machine at a stated speed and the current around the magnets. This relation given, it is easy to deduce what the result will be in all employments of the machine whether as a motor or to produce a current through resistance, through an electric arc, or in charging accumulators; also the result of varying the winding of the machine whether in the armature or magnets. The proper independent variable to choose for discussing the effect of a dynamo machine is the current around the magnets, and the primary relation it is necessary to know concerning the machine is the relation of the electromotive force of the armature to the magnet current. This primary relation may be expressed by a curve (Hopkinson, Mechan. Engin. Instit. Proc., 1879, pp. 246 *et seq.*, 1880, p. 266), now called the characteristic of the machine, and all consequences deduced therefrom graphically; or it may be expressed by stating the E.M.F. as an empirical function of the magnetising current. Many such empirical formulæ have been proposed; as an instance we may mention that known as Fröhlich's, according to whom, if $c$ be the current in the magnets, E the resulting E.M.F., $E = \frac{a c}{1 + b c}$. For some machines this formula is said to express observed results fairly accurately, but in our experience it does not sufficiently approximate to a straight line in the part of the curve near the origin. The character of the error in Fröhlich's formula is apparent by reference to sheet I. (plate 16), which gives a series of observations on a dynamo machine, and for comparison therewith a hyperbola, F, drawn as favourably as possible to accord with the observations.[†] Such empirical formulæ possess no advantage over the graphical method aided by algebraic processes, and tend to mask much that is of importance.[‡]

One purpose of the present investigation is to give an approximately complete construction of the characteristic curve of a dynamo of given form from the ordinary laws of electro-magnetism and the known properties of iron, and to compare the result of such construction with the actual characteristic of the machine. The laws of electro-magnetism needed are simply (Thomson, papers on "Electrostatics and Magnetism;" Maxwell, "Electricity and Magnetism," vol. 2, pp. 24, 26, and 143), (1) that the line integral of magnetic force around any closed curve, whether in iron, in air, or in both, is equal to $4 \pi n c$ where $c$ is the current passing through the closed curve, and $n$ is the number of times it passes through; (2) the solenoidal condition for magnetic induction, that is, if the lines of force or of induction be supposed drawn, then the induction through any tube of induction is the same for every section. Regarding the iron itself, we require to know from experiments on the material in any shape the relation between $a$, the induction, and $\alpha$, the magnetic force at any point; for convenience write $a = f^{-1}(\alpha)$, or $\alpha = f(a)$. From these premises, without any further assumption, it is easy to see that a sufficiently powerful and laborious analysis would be capable of deducing the characteristic of any dynamo to any desired degree of accuracy. This we do not attempt, as even, if successful, the analysis would not be likely to throw any useful light on the practical problem. We shall calculate the characteristic, first making certain assumptions to simplify matters. We shall next point out the nature of the errors introduced by these assumptions, and make certain small corrections in the method to account for these sources of error, merely proving that the amount of these corrections is probable or deducing it from a separate experiment, and again compare the theoretical and the actual characteristic.

*First approximation.*—Assume that by some miracle the tubes of magnetic induction are entirely confined to the iron excepting that they pass directly across from the bored faces of the pole pieces to the cylindrical face of the armature core. This, we shall find, introduces minor sources of error, affecting different parts of the characteristic curve to a material extent. Let I be the total induction through the armature, $A_1$ the area of section of the iron of the armature, $l_1$ the mean length of lines of force in the armature; $A_2$ the area of each of the two spaces between core of armature and the pole pieces of the magnets, $l_2$ the distance between the core and the pole piece; $A_3$ the area of core of magnet, $l_3$ the total length of the magnets. All the tubes of induction which pass through the armature pass through the space, $A_2$, and the magnet cores, and by our assumption there are no others. We now assume further that these tubes are uniformly distributed over these areas. The induction per square centimetre is then $\frac{I}{A_1}$ in the armature core, $\frac{I}{A_2}$ in the non-magnetic spaces, $\frac{I}{A_3}$ in the magnet cores; the corresponding magnetic forces per centimetre linear must be $f\left(\frac{I}{A_1}\right)$, $\frac{I}{A_2}$, $f\left(\frac{I}{A_3}\right)$. The line integral of magnetic force round a closed curve must be $l_1 f\left(\frac{I}{A_1}\right) + 2 l_2 \frac{I}{A_2} + l_3 f\left(\frac{I}{A_3}\right)$. In this approximation we neglect the force required to magnetise pole-pieces and other parts not within the magnet coils to avoid complication. The equation of the characteristic curve is then

$$4 \pi n c = l_1 f\left(\frac{I}{A_1}\right) + 2 l_2 \frac{I}{A_2} + l_3 f\left(\frac{I}{A_3}\right).$$

This curve is, of course, readily constructed graphically from the magnetic property of the material expressed by the curve $\alpha = f(a)$. In sheet I. curve A represents $x = l_1 f\left(\frac{y}{A_1}\right)$ the straight line B $x = 2 l_2 \frac{y}{A_2}$, curve C $x = l_3 f\left(\frac{y}{A_3}\right)$, and curve D the calculated characteristic. When we compare this with an actual characteristic, E, we shall see that, broadly speaking, it deviates from truth in two respects: (1) it does not rise sufficiently rapidly at first; (2) it attains a higher maximum than is actually realised. Let us examine these errors in detail.

(1) The angle the characteristic makes with the axis of abscissæ near the origin is mainly determined by the line B. We have, in fact, a very considerable extension of the area of the field beyond that which lies under the bored face of the pole-piece. The following consideration will show that the extension may be considerable. Imagine an infinite plane slab, and parallel with it a second slab cut off by a second plane making an angle, $\alpha$. We want a rough idea of the extension of the area between the plates by the spreading of the lines of induction beyond the boundary. We know that the actual extension of the area will be greater than we shall calculate it to be if we prescribe an arbitrary distribution of lines of force other than that which is consistent with Laplace's equation.

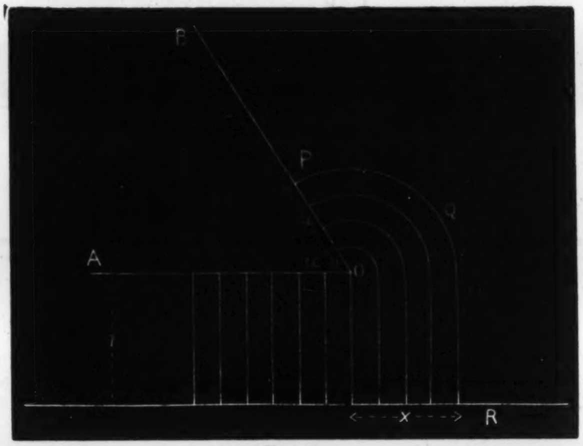

Fig. 1.

Assume, then, the lines of force to be segments of circles centre O, and straight lines perpendicular to O A. The induction along a line, P Q R, will be $\frac{V}{(\pi - \alpha) x + t}$, V being difference of potential between the planes, and the added induction from O P B will be

$$\int_0^x \frac{V\, d x}{(\pi - \alpha)x + t} = \frac{V}{\pi - \alpha} \log. \frac{(\pi - \alpha) x + t}{t}.$$

Thus if $\alpha = \frac{\pi}{2}$ we have for $x = t, 2t$, &c.

| $x$ | $\frac{1}{\pi - \alpha} \log. \frac{(\pi - \alpha) x + t}{t}$ |
|---|---|
| $t$ ... ... ... | ·599 |
| $2t$ ... ... ... | ·904 |
| $3t$ ... ... ... | 1·109 |
| $4t$ ... ... ... | 1·263 |
| $5t$ ... ... ... | 1·387 |
| $10t$ ... ... ... | 1·792 |

---

[*] From the Philosophical Transactions of the Royal Society.

[† Added August 17th.—That Fröhlich's formula cannot be a thoroughly satisfactory expression of the characteristic of a dynamo machine is evident from the consideration that E should simply change its sign with $c$, that is, be an odd function of $c$. There should be a point of inflexion in the characteristic curve at the origin. Another empirical formula $\frac{E}{a} = \tan.^{-1} \frac{c}{b}$ is free from this objection, but still fails to fully represent the approximation of the curve to a straight line on either side of the origin, and it is equally uninstructive with any other purely empirical formula.]

[‡] A number of sheet illustrations appended to the paper we do not propose to reproduce.—Eds. Elec. Rev.

showing that the extension of the area of the field is likely to be considerable.

(2) The failure of the actual curve to reach the maximum indicated by approximate theory is because the theory assumes that all tubes of induction passing through the magnets pass also through the armature. Familiar observations round the pole-pieces of the magnets show that this is not the case. If $\nu$ be the ratio of the total induction through the magnets to the induction in the armature we must, in our expression for the line integral of magnetising force, replace the term $f\left(\frac{\text{I}}{\text{A}_3}\right)$ by $f\left(\frac{\nu\,\text{I}}{\text{A}_3}\right)$; $\nu$ is not strictly a constant, as we shall see later; it is somewhat increased as I increases owing to magnetisation of the core of the armature, and it is also affected by the current in the armature. For our present purpose we treat it as constant.

There is yet another source of error which it is necessary to examine. Some part of the induction in the armature may pass through the shaft instead of through the iron plates. An idea of the amount of this disturbance may be readily obtained. Consider the closed curve A B C D E F, A B and F E D C are drawn along lines of force, A F and B C are orthogonal to lines of force. Since this closed curve has no currents passing through it, the line integral of force around it is nil; therefore, neglecting force along E D, we have force along A B is equal to force along F E and D C. In the machine presently described we may safely neglect the induction through the shaft; the error is comparable with the uncertainty as to the value of $l_1$; but in another machine, with magnets of much greater section, the effect of the shaft would become very sensible when the core is practically saturated.

The amended formula now becomes

$$4\,\pi\,n\,c = l_1 f\left(\frac{\text{I}}{\text{A}_1}\right) + 2\,l_2\,\frac{\text{I}}{\text{A}_2} + l_3 f\left(\frac{\text{I}}{\text{A}_3}\right) + l_4 f\left(\frac{\nu\,\text{I}}{\text{A}_4}\right) +$$
$$2\,l_5 f\left(\frac{\text{I}}{\text{A}_5}\right)$$

where $l_4$ is the mean length of lines of force in the wrought iron yoke, $\text{A}_4$ the area of the yoke, $l_5$ and $\text{A}_5$ corresponding quantities for the pole pieces, the last two terms being introduced for the forces required to magnetise the yoke and the two pole pieces.

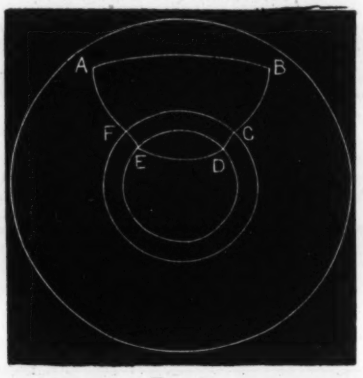

FIG. 2.

We now repeat the graphical method of construction exactly as before, the actual observations of induction in armature and current being plotted on the same diagram. Sheet II. (plate 17), in which curve, G, represents the force required to magnetise the yoke, and curve, H, that required to magnetise the pole pieces. Before discussing these curves further, and comparing the results with those of actual observation, it may be convenient to describe the machine upon which the experiments have been made, confining the description strictly to so much as is pertinent to our present enquiry.

### *Description of Machine.*

The dynamo has a single magnetic circuit, consisting of two vertical limbs, extended at their lower extremities to form the pole pieces, and having their upper extremities connected by a yoke of rectangular section. Each limb, together with its pole piece, is formed of a single forging of wrought iron. These forgings, as also that for the yoke, are built up of hammered scrap and afterwards carefully annealed, and have a magnetic permeability but little inferior to the best Swedish charcoal iron. The yoke is held to the limbs by two belts, the surfaces of contact being truly planed. In section the limb is oblong, with the corners rounded in order to facilitate the winding of the magnetising coils. A zinc base, bolted to the bedplate of the machine, supports the pole pieces.

The magnetising coils are wound directly on the limbs, and consist of 11 layers on each limb of copper wire, 2·413 mms. diameter (No. 13 B.W.G.), making 3,260 convolutions in all, the total length being approximately 4,570 metres. The pole pieces are bored to receive the armature, leaving a gap above and below, subtending an angle of 51° at the centre of the fields. The opposing surfaces of the gap are 8 mms. deep.

The following table gives the leading dimensions of the machine :—

| | cms. |
|---|---|
| Length of magnet limb ... ... ... | = 45·7 |
| Width of magnet limb ... ... ... | = 22·1 |
| Breadth of magnet limb ... ... ... | = 44·45 |
| Length of yoke ... ... ... ... ... | = 61·6 |
| Width of yoke ... ... ... ... ... | = 48·3 |
| Depth of yoke ... ... ... ... ... | = 23·2 |
| Distance between centres of limbs ... ... | = 38·1 |
| Bore of fields ... ... ... ... ... | = 27·5 |
| Depth of pole piece ... ... ... ... | = 25·4 |
| Width of pole piece measured parallel to the shaft ... ... ... ... ... | = 48·3 |
| Thickness of zinc base ... ... ... | = 12·7 |
| Width of gap ... ... ... ... ... | = 12·7 |

The armature is built up of about 1,000 iron plates, insulated one from another by sheets of paper, and held between two end plates, one of which is secured by a washer shrunk on to the shaft, and the other by a nut and lock-nut screwed on the shaft itself. The plates are cut from sheets of soft iron, having probably about the same magnetic permeability as the magnet cores. The shaft is of Bessemer steel, and is insulated before the plates are threaded on.

The following table gives the leading dimensions of the armature :—

| | cms. |
|---|---|
| Diameter of core ... ... ... ... | = 24·5 |
| Diameter of internal hole ... ... ... | = 7·62 |
| Length of core over the end plates ... | = 50·8 |
| Diameter of shaft ... ... ... ... | = 6·985 |

The core is wound longitudinally, according to the Hefner von Alteneck principle, with 40 convolutions, each consisting of 16 strands of wire, 1·753 mm. diameter, the convolutions being placed in two layers of 20 each. The commutator is formed of 40 copper bars, insulated with mica, and the connections to the armature so made that the plane of commutation in the commutator is horizontal, when no current is passing through the armature.

The dynamo is intended for a normal output of 105 volts 320 ampères at a speed of 750 revolutions per minute. The resistance of the armature measured between opposite bars of the commutator is 0·009947 ohm, and of the magnet coils 16·93 ohms, both at a temperature of 13·5° centigrade; Lord Rayleigh's determination of the ohm being assumed.

We have now to estimate the lengths and areas required in the synthesis of the characteristic curve.

$\text{A}_1$;—from the length of the core of the armature (50·8 cms.) must be deducted 3·4 cms. for the thickness of insulating material between the plates; the resultant area is, on the other hand, as has already been stated, slightly augmented by the presence of the steel shaft. $\text{A}_1$ is taken as 810 sq. cms.

$l_1$;—this is assumed to be 13 cms: *i.e.*, slightly in excess of the shortest distance (12·6 cms.) between the pole pieces.

$\text{A}_2$;—the angle subtended by the bored face of the pole-piece at the axis is 129°, the breadth of the pole-piece is 48·3 cms., the diameter of the bore of the field is 27·5 cms., and, as already stated, the diameter of core 25·5 cms., thus, the area of pole-piece is 1,513 sq. cms., and the area of 129° of the cylinder at the mean radius of 13·0 cms. is 1,410 sq. cms.; this value is taken for $\text{A}_2$ in the curves drawn on sheet I. (plate 16.) In sheet II. (plate 17) $\text{A}_2$ is taken as 1,600, an allowance of 190 sq. cms. being made for the spreading of the field at the edges of the pole-pieces, or $\frac{190}{160} = 1{\cdot}2$ cm. all round the periphery, that is $\frac{1{\cdot}2}{1{\cdot}5} = 0{\cdot}8$ of the distance from iron of pole-pieces to iron of core.

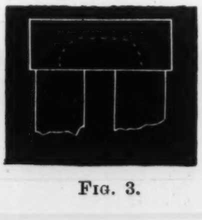

FIG. 3.

$l_2$ is 1·5 cm.

$\text{A}_3$ is a little uncertain as the forgings are not tooled all over, it is here taken as 980 sq. cms., but this value may be slightly too high.

$l_3$ is 91·4 cms.

$\text{A}_4$ is 1,120 sq. cms.

$l_4$ is 49 cms., being measured along a quadrant from the centre of the magnet thus :—

$\text{A}_5$ is 1,230 sq. cms., intermediate between the area of magnet and face of pole-piece.

$l_5$ is 11 cms.

$\nu$ was determined by experiment as described below, and its value is taken as 1·32; when the magnetising current is more than 5·62 ampères its value should be a little greater.

The function $f(a)$ is taken from Hopkinson, Phil. Trans., vol. 176 (1885), p. 455; the wrought iron there referred to was not procured at the same time as, and its properties may differ to a certain extent from, the wrought iron of these magnets.

The curves now explain themselves, the abscissæ in each case represent the line integral of magnetising force in the part of the magnetic circuit referred to, the ordinates, the number of lines of induction which also pass through the armature.

The results of the actual observations on the machine are indicated, those when the magnetising force is increasing +, when it is decreasing ⊕. The measurements of the currents in the magnets which were separately excited, and of the potential difference between the brushes, the circuit being open, were made with Sir W. Thomson's graded galvanometers, standardised at the time of use. The irregularities of the observations are probably due to the variation of speed, the engine being not quite perfectly governed. The second construction exhibits quite as close an agreement between observation and calculation as could be expected; the deviation at high magnetising forces is probably due to three causes, increase in the value of $\nu$ when the core of the armature is partially saturated, uncertainty as to the area $A_3$, difference in the quality of the iron. It is interesting to see how clearly theory predicts the difference between the ascending and descending curves of a dynamo. Consideration of the diagram proves that this machine is nearly perfect in its magnetic proportions. The core might be diminished by increasing the hole through it to a small, but very small, extent without detriment. Any reduction of area of magnets would be injurious, they might, indeed, be slightly increased with advantage. An increase in the length of the magnets would be very distinctly detrimental. Again, little advantage results from increasing the magnetising force beyond the point at which the permeability of the iron of the magnets begins to rapidly diminish. For iron of the same quality as that of the machine under consideration, a magnetising force of $2{\cdot}6 \times 10^3$ or 28·4 per centimetre is suitable. To get the same induction in other parts of the circuit, the diagram shows that for the air space a magnetising force of $21 \times 10^3$ is required, for the pole-pieces $0{\cdot}1 \times 10^3$, for the armature $0{\cdot}2 \times 10^3$, for the yoke $0{\cdot}6 \times 10^3$, making a total force required of $24{\cdot}5 \times 10^3$. Any alteration in the length or the area of any portion of the magnetic circuit entails a corresponding alteration in the magnetising forces required for that portion, at once deducible from the diagram. Similar machines must have the magnetising forces proportional to the linear dimensions, and, consequently, if the electromotive force of the machines is the same, the diameter of the wire of the magnet coils must be proportional to the linear dimensions. If the lengths of the several portions of the magnetic circuit remain the same, but the areas are similarly altered, the section of the wire must be altered in proportion to the alteration in the periphery of the section.

### *Experiment to determine $\nu$.*

Around the middle of one of the magnet limbs a single coil of wire was taken, forming one complete convolution, and its ends connected to a Thomson's mirror galvanometer rendered fairly ballistic. If the circuit of the field magnets, while the exciting current is passing, be suddenly short-circuited, the elongation of the galvanometer is a measure of the total induction within the core of the limbs, neglecting the residual magnetisation. If the short circuit be suddenly removed, so that the current again passes round the field-magnets, the elongation of the galvanometer will be equal in magnitude and opposite in direction.

The readings taken were:

Zero ... ... ... ... 71 left.
Deflection ... ... ... 332 „ magnets made.
„ ... ... ... 196 right; magnets short-circuited.
Hence, deflection to right = 267
„ left = 261
Mean deflection = 264

To determine the induction through the armature, the leads to the ballistic galvanometer were soldered to consecutive bars of the commutator, connected to that convolution of the armature, which lay in the plane of commutation.

The readings taken were:

Zero ... ... ... ... ... 23 left.
Deflection ... ... ... ... 223 „ magnets made.
„ ... ... ... ... 176 } right; magnets short-
„ ... ... ... ... 178 } [circuited.
Hence, deflection to right and left = 200

It thus appears that out of 264 lines of force passing through the cores of the magnet limbs at their centre, 200 go through the core of the armature, whence $\nu$ equals 1·32. The magnetising current round the fields during these experiments was 5·6 ampères.

### *Experiments on Waste Field not passing through Armature.*

As in the determination of $\nu$ a single convolution was taken around the middle of one of the limbs, and connected to the ballistic galvanometer; the deflections, when a current of 5·6 ampères was suddenly passed through the fields or short-circuited, were:

Zero ... ... ... 34 left.
Deflection ... ... ... 148 „ magnets made.
„ ... ... ... 82 right; magnets short-circuited.
Hence, deflection to right = 116
„ left = 114
Mean deflection = 115

I. Four convolutions were then wound round the zinc plate and the cast-iron bed in a vertical plane, passing through the axis of the armature; and the deflections noted:

Zero ... ... ... ... 15 left.
Deflection ... ... ... 61 „ magnets short-circuited.
„ ... ... ... 40 right; magnets made.
Zero ... ... ... ... 11 left.
Deflection ... ... ... 64 „ magnets short-circuited.
„ ... ... ... 36 right; magnets made.
Hence, deflection to right = 55
„ left = 46
and deflection to right = 47
„ left = 53

in the two observations respectively, giving a mean = 50·25; or, reducing to one convolution, = 12·6.

II. A square wooden frame, 38 cms. × 38 cms., on which were wound 10 convolutions, was then inserted between the magnet limbs, with one side resting on the armature, and an adjacent side projecting 5 cms. beyond the coils on the limbs, or about 7·6 cms. beyond the cores of the limbs. The deflections were:

Zero ... ... ... ... 34 left.
Deflection ... ... ... 98 „ magnets made.
„ ... ... ... 22 right; magnets short-circuited.
„ ... ... ... 21 „ „ „
„ ... ... ... 81 left; magnets made.
Hence, deflection to right = 56
„ left = 64
and „ right = 55
„ left = 47

in the two observations respectively, giving a mean = 55; or reducing to one convolution, = 5·5.

III. The same frame was raised a height of 6·35 cms. above the armature in a vertical plane. The deflections were:

Zero ... ... ... 21 left.
Deflection ... ... 98 „ magnets made.
Zero ... ... ... 35 left.
Deflection ... ... 8 right; magnets short- [circuited
Hence, deflection to left = 50
„ right = 43
and mean deflection = 46·5
or, reducing to one convolution = 4·6

IV. The same frame was again lowered on the armature and pushed inwards so as to lie symmetrically within the space between the limbs. The deflections were:

Zero ... ... 32 right.
Deflection ... 112 „ magnets made.
„ ... ... 48 left; magnets short-circuited.

giving a mean of 80; or, reducing to one convolution = 8·0.

Let G represent the leakage through a vertical area bounded by the armature, and a line 7·6 cms. above the armature, and of the same width as the pole pieces; let R be the remainder of the leakage between the limbs; then II. and III. give;

$$\frac{2}{3}G + \frac{2}{3}R = 5{\cdot}5$$

$$\frac{2}{3}R = 4{\cdot}6$$

whence

$$G = 1{\cdot}35$$

$$R = 6{\cdot}9$$

Again IV. gives

$$\frac{5}{6}G + R = 8{\cdot}0$$

therefore

$$G + R = 9{\cdot}6$$

which shows an agreement as near as might be expected considering the rough nature of the experiment, and that the leakage is assumed uniform over the areas considered.

We take

$$G = 1{\cdot}6$$

$$R = 8{\cdot}0$$

Reducing these losses to percentages we have

$G = \frac{1{\cdot}6}{115}$ ... ... ... ... ... = 1·4 per cent.
$R = \frac{8{\cdot}0}{115}$ ... ... ... ... ... = 7·0 „
And from I. the leakage through the zinc plate and iron base ... } = 10·3 „
Hence the two gaps account for ... ... 2·8 „
The zinc plate and iron base account for 10·3 „
And the area between the limbs ... ... 7·0 „
Making a total loss accounted for ... 20·1 „
Out of an observed loss of ... ... 24·24 „

The leakage through the shaft and from pole-piece to yoke, and one pole-piece to the other by exterior lines, will account for the remainder.

*(To be continued.)*

# THE BRITISH ASSOCIATION.

## THE ELECTROLYTIC WORK OF KOHLRAUSCH.*

By E. F. J. LOVE.

*(Section A.—Mathematical and Physical Science.)*

*Tuesday, September 7th.*

THIS memoir is an extension of previous work, and was undertaken for the purpose of verifying the following laws laid down by Kohlrausch in a former paper :—

1. If dilute solutions of various salts be prepared, having their strengths proportional to the chemical equivalents of the salts, then the special conductivities of these solutions are of the same order of magnitude.

2. In dilute solutions, under a given electromotive force, each of the ions moves through the liquid with a fixed velocity dependent on its own chemical nature, and independent of that of the other ion. This is termed the "law of independent migration."

3. The influence of change in temperature upon the conductivity tends, as dilution increases, to a limiting value, the temperature coefficient being the same, within narrow limits, for all neutral salts.

In his previous investigations Kohlrausch had determined the specific conductivities of solutions of varying strength, from saturation down to a few per cents., and from observations thus obtained had deduced the conductivity in more dilute solutions by extrapolation. In the present memoir he verifies and corrects the results thus obtained by the employment of solutions whose strengths vary from 1·0 to 0·00001 gramme-equivalents per litre. (The strength thus estimated is termed the "molecular content.")

In measuring the resistances a Wheatstone bridge is used, with alternating currents and a telephone as indicator (the paper deals at some length with the advantages and difficulties of this method); the specific conductivities are expressed in terms of that of mercury, and calculated for a uniform temperature of 18° C.

In working up the results the conception of "specific molecular conductivity" is employed, this being defined as the ratio $k/m$ of the specific conductivity $k$ of the solution to the molecular content $m$. As the specific molecular conductivities are all very small, Kohlrausch tabulates the values of $10^8 . k/m$, instead of $k/m$ simply. The values of this ratio are exhibited graphically, by plotting in a curve, with $m^{\frac{1}{3}}$ as abscissa, this quantity being chosen because it expresses "the reciprocal of the mean distance, or, in other words, the *mean relative proximity* of the molecules—*i.e.*, the magnitude on which the speific molecular conductivity is most directly dependent.

The material thus obtained is amply sufficient to verify the three statements above mentioned, the very important law of independent migration in particular receiving a full confirmation. In addition, a large number of interesting relations disclosed themselves, which may be summarised as follows :—

1. If the solution be sufficiently dilute the specific molecular conductivity $k/m$ is, for all neutral salts, independent of the strength of the solution, or each molecule conducts the current independently of every other. In other words, the specific molecular conductor has a limiting value. These limiting values are not the same for all salts, or even for those of the same base or acid; their magnitude depends on the nature of both ions.

2. The velocity with which the ions move past each other in extremely dilute solution, under an electromotive force of 1 volt per linear millimetre, is determined in millimetres per second by multiplying the specific molecular conductivity of the electrolyte by 11,000† (or Kohlrausch's tabulated numbers by 0·00011). The numbers thus obtained for the various salts examined all lie between 0·14 and 0·10 *m m/sec.*

3. The specific molecular conductivity of a salt in dilute solution being proportional to the sum of the velocities of the separated ions, the values of these absolute velocities may, as Kohlrausch had shown previously, be determined from the experiments in the following way :—

Let $u_1$ and $v_1$ be the absolute velocities of K and Cl, $u_2$ and $v_2$ those of Na and Br ; then the

Specific molecular conductivity, $k/m$ of K Cl $= (u_1 + v_1)/11000$
" " " " Na Cl $= (u_2 + v_1)/11000$

and so on ; hence the conductivities of K Cl, Na Cl, K Br, and Na Br, contain all that is necessary for determining the absolute velocities of K, Na, Cl, and Br ; since by the law of independent migration the velocity of Br, for instance, is the same in K Br as in Na Br.

Employing numbers thus determined Kohlrausch has calculated the specific conductivities of a number of salts in dilute solution; and the calculated and observed values show a satisfactory agreement.

4. As the strength of the solution increases the specific molecular conductivity slowly diminishes. It may be approximately represented by the formula

$$k/m = \mathrm{A} - \mathrm{B}m^{-\frac{1}{3}}$$

and since $m^{-\frac{1}{3}}$ = the relative mean distance $r$ of the molecules,

$$k/m = \mathrm{A} - \mathrm{B}/r,$$

or "the specific molecular conductivity is equal to a constant diminished by a quantity inversely proportional to the mean distance of the molecules."

5. The rate of diminution of $k/m$ with increasing concentration is greater the higher the valency of the ions. This is ascribed to two possible causes—(*a*) a change in the constitution of the polyvalent ion, in virtue of which it approximates in behaviour to a monovalent ion, as the dilution increases; (*b*) the possibility that the current may be in part conveyed by the water of the solution.

6. The specific conductivity of a salt appears to be unaffected by its possessing, or being destitute of, water of crystallisation.

The above conclusions refer only to neutral salts; acids and alkalis (including alkaline carbonates) behave in a different manner. The chief facts collected by the author regarding these substances are—

1. The specific molecular conductivity of acids and alkalies is small if the dilution be very great, increases with the strength of the solution up to a certain maximum, and from this point diminishes as the concentration increases. The small initial value of $k/m$ he considers (following Arrhenius and Ostwald) to be a secondary phenomenon—probably due to impurities in the water—and accordingly he neglects this part of the curve, and obtains the limiting value of the specific molecular conductivity by producing the second part backwards through the maximum to the line of ordinates. He thus obtains as the maximum limiting velocity of the ions 0·4 *mm/sec*, under an electromotive force of 1 volt per linear millimetre.

2. The alkalies KOH and NaOH have specific molecular conductivities differing by a small constant amount, as also have their carbonates.

3. The monobasic mineral acids have the same specific molecular conductivity. Phosphoric acid gives a nearly identical value if, instead of the equivalent $\frac{1}{3}$ $H_3PO_4$, we employ the whole molecule $H_3PO_4$.

4. Acetic acid and ammonia in dilute solution exhibit a specific molecular conductivity nearly proportional to $m^{-\frac{1}{2}}$. In strong solution they conduct very badly.

5. Sulphuric acid is anomalous, exhibiting three maxima and two minima. The first minimum corresponds to the hydrate $H_2SO_4.H_2O$, and the second to concentrated $H_2SO_4$. One of the maxima occurs between this point and $SO_3$. This behaviour points to a chemical change in the structure of the molecule depending on the concentration.

With regard to the problem of electrolytic conduction in general, Kohlrausch lays down the axiom that no electrolyte in a pure state is a good conductor, but only becomes such on admixture with other bodies, this admixture being necessary in order to set up the dissociation which Clausius looks upon as the cause of migration of the ions. In this connection the question is discussed as to whether the water of a solution conducts part of the current. This our author considers extremely likely, as such a circumstance would explain various anomalies.

Kohlrausch discusses Bouty's "law of equivalents," which states that "the electric conductivity of dilute salt-solutions of equivalent strengths is the same for different substances." Bouty distinguishes between "normal" salts, which obey the law, and abnormal salts, which do not; and defines an abnormal salt as one "whose constituent ions in dilute solution travel with different velocities." But Kohlrausch shows that some salts which would come under this definition obey Bouty's law, while some of the salts which disagree with it can be shown to be "normal," from observations on their migration-constants. He also objects to the law on the ground of its inherent improbability, and alleges further that Bouty's method of calculation is erroneous. The cases, therefore, of agreement with the law he looks on as coincidences.

Among minor points of interest brought out by the investigation are the following :—

1. The low conducting power of nearly pure water, the smallest value obtained being $0·25 \times 10^{-10}$.

2. The phenomenon of absorption by the electrodes. The conductivity of a very dilute solution of H Cl was found to slowly diminish owing to the withdrawal of the acid from the solution. That this is due to the electrodes was shown by an increase in the resistance on sinking them in the fluid, the higher conductivity being restored by stirring. The phenomenon is not exhibited by solutions of neutral salts.

3. The specific molecular conductivity of a strong base or acid is diminished by gradual neutralisation, reaches a strongly defined minimum when neutralisation is complete, and thence increases. Phosphoric acid shows several such minima; acetic acid gives a curve of *gradually* changing curvature, the neutralisation point being apparently somewhat indefinite.

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* Abstract of F. Kohlrausch's Paper, "Ueber das Leitungsvermögen einiger Electrolyte in äusserst verdünnter wässeriger Lösung" (*Wied. Ann.* XXXVI. p. 161).

† [This appears to be necessary in order to reduce measures in terms of mercury to absolute measure.—E. F. J. L.]

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## ON CONTINUITY OF ELECTRIC CONDUCTION.

By Dr. HOPKINSON.

IN my experiments on residual charge I touched upon the second question in Lodge's programme ("Is Ohm's law obeyed by very bad conductors?"), and pointed out that Ohm's law could be regarded as a limiting case of a more general law of superposition. In the case of mechanical after-effects the law of superposition does not hold even approximately. The fourth question ("Is there any relation between optical opacity and electrolytic conductivity?") appears to me to be very intimately associated with the fact that bodies which, if they conducted, would be electrolysed do not follow Maxwell's law, whereas some other insulators do. My own present impression is that an electrical displacement in glass may, although continuous, be roughly divided into four successive stages. 1st. A yielding of the dielectric during a time corresponding to the time of wave frequency of light, for which $K = 2\frac{1}{2}$ about. 2nd. A further yielding during a time corresponding to great absorption below the red, bringing $K$ up to from 6 to 10. 3rd. A further slow yielding, partly recoverable, hardly sensible in time less than a second or such like, and going on with diminishing amount for days. 4th. A yielding corresponding to an actual decomposition of the material. Superposition probably applies to all these continuously connected successive events. Probably if we could experiment fast enough on any ordinary electrolyte, like solution of $Cu\,SO_4$, we should find a similar succession of phenomena.

[Dr. Hopkinson's note is of extreme interest, and the references to his papers are as follows:—"Residual Charge in Leyden Jar," *Phil Trans.*, January, 1877; "Strain in Glass Fibre," *Proc. Royal Society*, October 4th, 1878; "Refractive Index and Specific Inductive Capacity," *Phil. Mag.*, April, 1882. This last paper I may abstract thus:—

Maxwell's laws are that $\mu^2 = K$, and that transparent bodies must insulate. They are true for mineral oils and solid paraffin; not true for glass, Iceland spar and organic oils. Consider, for instance, light flint glass: $K$ is 6·7 for disturbances whose period is longer than $10^{-5}$ second, and for these disturbances it behaves as an insulator. It ought, therefore, for such waves to be transparent, and to have an index 2·6. But, for disturbances of period about $10^{-15}$ second, its index, reckoned for very long waves by extrapolation formula, comes out about 1·5. Is there any way of accounting for this discrepancy? Yes; perhaps by the known fact that on waves *between* these two periods glass exercises a strong selective absorption, and that this is usually accompanied by anomalons dispersion, which at once renders all empirical reasoning towards the state of things for very long waves, from the observed condition for very short waves, utterly futile and misleading. Perhaps, therefore, Maxwell's law is after all obeyed by these substances for long waves, and one way to test the question is by using rays from a thermopile to a freezing mixture.—O. L.]

## ON THE ELECTRIC RESISTANCE OF MAGNETITE.

By Prof. SILVANUS P. THOMPSON, D.Sc.

THIS is a preliminary note on a research begun with the view of elucidating the question whether the conduction exhibited by various mineral ores and metallic oxides and sulphides possessing quasi-metallic conductivity is or is not accompanied by electrolysis. The substance selected, magnetite or magnetic iron ore, is a thoroughly good conductor, as is evidenced by the simple fact that if a piece of it be interposed in the circuit of an ordinary electric bell the bell can be rung through it.

The sample selected was a fine homogeneous piece of ore from Arkansas, and was reduced by the lapidary's wheel to a parallelipipedal bar. Its total length was 5·53 centimetres, its breadth 1·52 centimetre, and its thickness 1·27 centimetre.

The bar was placed between electrodes of platinum foil, which were clamped against its end faces by means of screws; it was then placed in a bath of paraffin oil, enabling it to be heated to any desired temperature up to 135° C.

To test for electrolytic polarisation a current of about 1 ampère was passed through it from three nitric acid cells for some minutes. On stopping the current there appeared a slight polarisation, not, however, exceeding 0·0005 volt, and therefore of an order indicating a thermo-electric rather than an electrochemical origin.

The specific resistance was then measured by observing the fall of potential between two marked points 3·22 cemtimetres apart upon the bar, and comparing this with the fall of potential between the two ends of a standard resistance coil, intercalated in the same circuit. The resistance was found to diminish very remarkably as the temperature was raised. Observations were made at intervals of from 20 to 40 minutes apart, with the following result:—

| Temperature (C.). | Resist. of centimetre cube in B. A. units. |
|---|---|
| 23° | 0·719 |
| 54° | ·709 |
| 79·5° | ·505 |
| 107° | ·416 |
| 133° | ·287 |

It appears that the resistance of magnetite agrees with that of carbon and the electrolytes in possessing a negative temperature coefficient.

A somewhat longer and thinner bar of hæmatite prepared for future experiments showed a resistance of about 108 megohms, which in a preliminary heating fell to 81 megohms.

The determinations were made by the author's chief assistant, Dr. R. M. Walmsley.

## THE MARCHANT ENGINE.

WE intimated to our readers in our last issue that we might possibly have another opportunity of inspecting this engine during the week, and we are now enabled to place before them additional facts; but, unfortunately, the results obtained do not bear out the data published in the REVIEW for September 17th.

The controversy which has been carried on in our own pages, and in the columns of *Engineering*, the *Engineer*, and *Industries*, from the very moment of the publication of our article, shows that a lively interest was thereby created, but the bulk of the correspondence has been to show that the economy of fuel consumption claimed for the Marchant engine was an impossibility, and that therefore the testing arrangements must have been faulty. The following facts will show beyond the shadow of a doubt that such was the case.

It was, we think, generally understood at the time our representative compiled the data referred to above, that we were not asked to report professionally upon the engine, and it was only upon the open invitation of the Marchant Engine Syndicate to anyone interested in the invention to inspect and experiment with the apparatus that we entered into the matter, thinking that should the engine be all that had been said of it, electric light engineers would, with its assistance, be better able to compete with gas in price. Two reports (one based upon indicator diagrams) had already been published, each signed by several engineers, to the effect that one brake horse-power was produced with a coal consumption of less than one pound of coal per hour.

The tables published by us are now matters of history and need not be repeated here.

After reading the letters of Messrs. Garrett and Hollick in last week's *Engineering*—two of the gentlemen be it known, who had signed one of the reports just mentioned—who had recently examined the brake by which the horse-power of the engine had been tested, we deemed it advisable to at once proceed with another and personal investigation into the matter, and Mr. Marchant placed the engine and his men at our disposal. Accompanied by Mr. Macfarlane Gray and Mr. Reckenzaun, we journeyed to the Bow works of Messrs. Fraser and Fraser on Wednesday morning, and in a very short time we were enabled to form a real estimate of the Marchant engine. Upon our arrival the engine was running merrily enough at some 140 to 150 revolutions and giving a pull of over 200 lbs. on the Salter's balance. We had it stopped, and the pit, in which the lower half of the brake is sunk, pumped free from water, for until this was accomplished no proper examination could be made. The stop, F, had been already removed, but we found stop, E, in its place with its "Timmis" spring, of the existence of which we became aware only on perusal of the letters of Messrs. Garrett and Hollick. The effect of this block and spring—the latter might have readily escaped detection by one ignorant of its existence, even upon a close examination—upon the brake action will be understood by reference to that which follows.

Upon knocking away block E, the brake became of the simple Prony type, and we found no difficulty in its manipulation, notwithstanding the warnings we had received that no reliable pull could be obtained on the Salter's balance with the brake free of these encumbrances. With a pressure of 250 lbs. of steam in the boiler, the engine was invariably stopped with a pull of less than 100 lbs. on the Salter's balance. We made repeated trials, but these were of no avail, and we are now forced to admit that this pull is only about one-third of that registered with the brake as submitted to us in September. Naturally, we took no notice of fuel consumption, as we could not get anything like the horse-power which was anticipated; therefore our readers can accept our former data as to coal, and modify the horse-power to their own tastes.

It may perhaps be well to remark here that the brake of 720 lbs. does not add a very great percentage of weight to the axle of the flywheel, which itself weighs 2 tons, and that it was a matter of surprise that the friction produced by the dead weight of the brake upon the flywheel when running at nearly 200 revolutions per minute produced so small a pull on the Salter's balance, not more than 10 lbs; the brake, however, appeared to be somewhat heavier on one side than the other.

After this disclosure we cannot but agree with *Engineering*, that Messrs. Marchant and Downie owe a full and ample explanation to those who in a moment of weakness accepted their assurances as to the construction and action of the brake.

The discovery that the rolling piece, E, is placed nearly 12 inches from the vertical line passing through the centre of the fly-wheel, as well as the fact that a stiff Timmis spring is employed to press up the brake-block to the rim of the wheel, is so inconsistent with the description given us, both verbally and in writing, as to change the whole conditions under which we believed the brake to be working. These inaccuracies and reservations, which must appear to some to have been more than accidental, upset entirely all the figures and data deduced from our trial, and no amount of specious argument or explanation will avail to restore our confidence in the reliability of any material information supplied to us. We were probably to blame in taking so much on trust, but the apparatus being already fitted for the purpose, we contented ourselves with the assurances of the gentlemen representing the Marchaut Syndicate that there was no pressure on the points E and F when the brake was in action and the engine running. Not only did we take their statement of facts to that effect, but we were led to believe that E was barely—perhaps an inch or two—out of centre, and Mr.

Marchant, in a letter describing the brake, says, "I therefore arranged a rolling piece to the *centre* of the bottom piece of the brake, E, and put a stop, F, so that as far as was practicable the pull of the clip should be shown by the spring balance without friction and weight of brake." Our representative examined—at a time when the arrangements were unshipped—the loose bits of wood, of which the supports were said to be composed, and the rolling piece, consisting of a semi-cylindrical piece of wood packed up with other thin pieces, not connected together, except by their friction on one another; no spring was visible anywhere about and no mention was made of such a thing being used at E, so we concluded that the support was non-elastic.

The presence of the Timmis spring in the position given by Mr. Garratt will fully account for a fact which we could not at the time provide a reason for; we noticed that the scale readings went up more rapidly than they fell, the latter course being characterised by sluggishness.

On suggesting that the blocks, E and F, should be dispensed with and the brake used in the ordinary fashion, we were informed that it had been tried in that way, when it was found that the unevenness of motion of the frictional surfaces, combined with the sudden jerks attendant thereon, rendered it utterly impossible to take readings and nearly smashed up the entire arrangement. We therefore gave our results, relying on the above assurances, luckily giving a diagram of the brake to enable the public to consider whether the conditions under which the tests were made could be looked upon as trustworthy or not, although we could scarcely believe that any management of an important concern would care to disseminate figures and reports which were not strictly true, having the certain and positive knowledge that the more publicity they obtained the sooner would the errors be pointed out and the unpleasant day of reckoning arise. We can only trust that Mr. Marchant and his colleague Mr. Downie were in ignorance of the effect produced by "block E," as in that case only can they be absolved from severe censure in the matter.

## NOTES.

**The Brighton Electric Light Company.**—This company seems in a fair way to remove, so far as its particular district is concerned, the stigma which electric lighting in its commercial aspect has hitherto laboured under, for a dividend of 4 per cent. has just been recommended by the directors. We would like to know whether it is an accidental coincidence that a new issue of shares is proposed.

**Lighting the "Liberty" Statue.**—The Bartholdi statue, at New York, was illuminated by the electric light for the first time on the night of Monday week, being the first pleasant evening since the unveiling. The torch was lighted by nine arc lights arranged in two horizontal circles, one inside the other. There are five 8,000 candle-power electric lights in five of the salient angles of the fortifications surrounding the statue. Behind each light is a reflector, by which the light is focussed on the pedestal and statue. Each light is four times as powerful as an ordinary arc light. The lighting was witnessed by enormous assemblages of people at the Battery, and along the wharves. The water was alive with craft of all kinds. When the signal for lighting was given fireworks in bewildering profusion blazed from the forts, islands, wharves, and vessels, followed almost immediately by a flashing white light from the torch, which sent dazzling rays over the waters of the harbour and far out to sea. The effect was marvellously beautiful. Tremendous roars of delight broke from thousands of throats, accompanied by the shrill whistles of every tug and steamer in the harbour. The lighting of the torch was pronounced successful, but that of the statue itself not. Held high above the statue's head, the light from the torch makes a brilliant beacon for the entire harbour, and is plainly visible for many miles at sea.

The statue of "Liberty" has remained unlighted since Saturday last for want of funds, Congress having voted none for the purpose.

**Electric Light Challenges.**—We have already stated that a challenge was issued on the 1st ult., by the general manager of the American Electric Manufacturing Company to all parent or manufacturing electric light companies in the United States to meet the American Company in an open and exhaustive competitive test for one month. The thirty days time offered in which to accept the challenge expired without any company accepting the challenge. The American Company has shown the courage of its convictions, and declared itself willing and ready to meet all comers in an exhaustive test of real merits of the various systems for $1,000 a side. Mr. Goff, the general manager, is said to have some very important and valuable improvements which will be added to the present system, when he intends offering a permanent challenge for $5,000 or $10,000 a side.

**A New Electric Light.**—A patent has been issued, according to information from Washington, to George Westinghouse, jun., of Pittsburg, Pa., inventor of the Westinghouse air brake, for a new system of distributing electricity to be used in lighting and for other purposes, which, it is said, will greatly cheapen the electric light and render it a more dangerous rival of illuminating gas than it has ever yet become. The new invention will, it is alleged, effect a saving of about 95 per cent. in the distributing main wires as compared with the Edison "three-wire system." In tests of the invention a single main circuit of wire less than one-fourth of an inch in diameter carried the current for 850 16-candle-power incandescent lights, all situated at a distance of three miles from the dynamo. The inventor claims that to light this number of lamps at an equal distance the Edison system would require from 90 to 100 wires of the same size.

**Electric Lighting in Germany.**—The gas authorities of the town of Bochum propose to establish a central station, from which to light the streets and the principal buildidgs by electricity. It appears that the little town of Darkehmen, situate in the extreme east of Germany, claims the honour of being the first town on the Continent to be lighted wholly by electricity. Darkehmen is built on the two sides of a valley, down which runs a small river, the Angeragg. From a fall on this river is derived the motive force required to drive the dynamo-electric machines which furnish the lighting currents.

**The Secretary of State for Scotland on the Telephone Companies.**—At Edinburgh last week a deputation from the Edinburgh Chamber of Commerce brought under the Scotch Secretary's notice several matters including telephones. The Chamber was very anxious that the Government should be careful to see that no vested interests were created, as was done in the case of the telegraphs, where the parties became possessed of a valuable right which had to be redeemed at a great cost. Mr. Balfour, in reply, expressed the pleasure it had given him to hear that what he had said on private bill legislation had commended itself to the Chamber of Commerce. As to the subject of telephones, he could not say that he had any mature opinions on the subject; but one thing they would have to take care of was that they should not so overload the matter with restrictions as to crush out private enterprise, in the same way as had been done with the electric light. As to the other point, he would leave the Lord Advocate to deal with it. The Lord Advocate said he thought it should be known that the Government, in purchasing the telegraph companies, also purchased the sole right in the country to make communication from one place to another by means of electricity. In consequence of that no telephone company could start without a license from the Government.

**West-End Telephone Exchange.**—For some months the New Telephone Company has been preparing to institute a West-End local telephone exchange, to connect together the householders of Kensington, Chelsea and Belgravia with the chief tradesmen of the district.

The canvass that has been undertaken as a preliminary step appears to warrant the expectation that a local exchange putting householders in direct communication with their own butcher, baker, fruiterer and physician, will prove a great financial success. The New Telephone Company not being hampered with the great burden of costly patents and other dead capital, and having adopted from the first the policy of selling its instruments outright, will be able to establish such a local exchange on terms much more advantageous to the local syndicate who will work the exchange than could otherwise be the case.

**Telephone Manufacturing Case.**—Last week Mr. Justice Stirling, at the instance of Mr. D. J. Callow, granted a perpetual injunction against Mr. F. Young, restraining him from taking part in any business relating to the manufacture or sale of telegraph, telephone or bell cases. The plaintiff in September, 1884, acquired the business of Messrs. Heaton and James, of which firm defendant had previously been a member, but which he left in November, 1883, entering into an undertaking not to carry on a similar business within 100 miles of the Royal Exchange. In 1884 defendant took premises in Clerkenwell and there conducted a business in all respects similar to that which he had previously carried on. The business was not conducted in his own name, however, but in that of one of his workmen.

**Shopping by Telephone.**—A novel experiment is about to be made by the United Telephone Company at Kensington. The company proposes to connect a number of first-class residences in that locality with the local exchange, and to allow the tradesmen the opportunity of communicating with their customers, or *vice versâ*, for an annual payment of £1 per house, and an additional £1 for every £100 worth of orders received by telephone.

**The Atlantic Cable War.** — The speculators in American cables who are predicting a settlement of the existing cable war, says the *Financial News*, can hardly have taken into account the personal relations of Mr. James Gordon Bennett and Mr. Jay Gould. There is between these two gentlemen war to the knife, "and the knife to the hilt:" it is not a business quarrel, but a most bitter personal feud, and, unless Mr. Bennett says a great deal more than he means, nothing but death can end it. The visit of Mr. Jay Gould's private detectives to Vienna failed of its purpose, but Mr. Bennett is not the more likely either to forgive or forget it.

**A Large Dynamo.** — The Van Depoele Electric Manufacturing Company is said to be engaged with a large dynamo for the Montgomery, Ala., street railway people. Some of the dimensions will give a better idea of the size of the machine. The armature is 28 inches diameter, and 40 inches long. Total length of the machine, front view, 10 feet; height, 4 feet; width, 4 feet. Its capacity is 200 horse-power. Al the street lines of railway in Montgomery diverge from one central station, and at this point the generator will be placed, and furnish power for the motors, 12 in number, of 10 horse-power each. Extensions of the road are now being made, which will, when finished, place under the control of this one machine 20 motor-cars and about 15 miles of track. This form and size of generator, according to the New York *Electrical Review*, has been decided upon by the Van Depoele people as of standard size and capacity, and is such as will hereafter be placed on their various lines of street railway, and from present appearances there will be many new ones constructed in the very near future.

**Electric Roads in America.**—Chicago, Baltimore, Philadelphia, Minneapolis, Toronto, and other cities already have electric street railways in successful and profitable operation. About a dozen new roads are in course of construction, and a score or two more are projected.

**A Runaway Steam Tramcar.**—The passengers on Sunday night by the last steam tramcar from Dudley to Wolverhampton were considerably alarmed on arriving at their destination to find that the engine had left the rails, and was proceeding at considerable speed along the road. Turning aside on to the footpath, the further course of the locomotive was checked by the indentations one of the wheels made in the pavement. It was then discovered that the engine driver was missing from his post. He came up soon after and explained that, having got down to go to the back of the car, the engine suddenly started off without him. The car was full of passengers at the time, and although, fortunately, no one was injured, they had all a very narrow escape.

**The Royal Society.**—The following is the list of selected names to be submitted to the Fellows of the Royal Society at the forthcoming anniversary meeting (November 30th) for election into the Council for the ensuing session:—President—Professor George Gabriel Stokes, M.A., D.C.L., LL.D. Treasurer—John Evans, D.C.L., LL.D. Secretaries—Professor Michael Foster, M.A., M.D., and the Lord Rayleigh, M.A., D.C.L. Foreign Secretary — Professor Alexander William Williamson, LL.D. Other members of the Council—Prof. Robert B. Clifton, M.A., Prof. George Howard Darwin, M.A., LL.D., W. T. Thistleton Dyer, M.A., Prof. David Ferrier, M.A., Edward Frankland, D.C.L., Arthur Gamgee, M.D., Archibald Geikie, LL.D., Prof. Joseph Henry Gilbert, M.A., John Hopkinson, M.A., D.Sc., J. Norman Lockyer, F.R.A.S., Sir Lyon Playfair, K.C.B., LL.D., Prof. Bartholomew Price, M.A., Prof. Pritchard, M.A., Admiral Sir George Henry Richards, K.C.B., Prof. Arthur Schuster, Ph.D., and Philip Lutley Sclater, M.A.

**The Schlesinger Tramway System.**—The *Franklin Institute Journal* contains an illustrated description of the Schlesinger electrical tramway system. It also appears in the New York *Electrical World* for October 30th, but we do not see anything sufficiently novel in it to make it worth reproducing in our columns; we will merely mention that it seems to be a mild imitation of Mr. Holroyd Smith's ideas.

**The Kensington Agricultural Hall.**—It is expected that the electric lighting plant for "Olympia" will be completed by the end of the month. Even now there are in position four dynamos of 40 units, and two sets of compound engines of 200 H.P. each. The great hall will be lighted with 54 lamps, taking 12 ampères, and arranged in nine basket lanterns, six in each. The machines, which, as we have previously said, are to a certain extent on the Edison-Hopkinson lines, were constructed to run at 500, but they do their work at 380 revolutions per minute.

**Electric Buoy.**—Experiments made with an electric buoy at Asnières, near Paris, gave good results. The buoy weighs 38 kilogrammes, and it contains six Gadot accumulators, through which a 6 candle-power lamp is fed; the lamp is placed one metre above the water line. The light can be seen a distance of three nautical miles, and the lamps burn for six hours. As soon as the call, "Man overboard," is raised, the man on watch cuts the tow line at the stern of the ship; the ends drop into the sea water, which completes the circuit, so that the lamp is lighted automatically.

**Turbines.**—In the *Journal of the Franklin Institute* for November, a paper, teeming with mathematical expressions, is published on "Turbines," by J. Lester Woodbridge, M.E., of the Stevens Institute of Technology. The paper is to be continued, and, according to Prof. De Volsen Wood, it gives the most general solution of the frictionless turbine yet made.

**Society of Arts.**—Major-General Webber, R.E., is announced to read a paper before the Society of Arts, on December 8th, on "Glow lamps: their use and manufacture." A paper on "The development of the mercurial air pump" will be read on some date not yet fixed, by Prof. Silvanus P. Thompson, B.Sc.

**An Electric Boat in Berlin.**—The last number of *Centralblatt für Elektrotechnik* boasts that Berlin also has an electric boat surpassing in dimensions as well as capabilities the launch which recently made the voyage across the channel. This new boat is the property of Messrs. Siemens and Halske, and it carries 80 accumulators and a 5½ H.P. motor. The boat is said to run for three hours with one charge. The dimensions of the hull are 37 feet long, 6½ feet beam; it draws 2 feet 7½ inches of water, and is capable of accommodating 20 persons. Our readers will recollect that the *Volta*, which no doubt is the boat referred to above, is of the same length and more beam, whilst drawing only 2 feet of water. The *Volta* has seating accommodation for 40 passengers, and the 61 cells supply a continuous current for nine hours, when the motor uses 4½ H.P. of energy; working it at 5½ H.P., like the one of Messrs. Siemens and Halske, it will run for seven hours with one charge. The maximum power of the *Volta* apparatus is 12 H.P. It appears that the Germans are far behind us in matters of secondary batteries and electric boats; the *Electricity*, which was on the Thames four years ago, was far superior to the craft which figured on the river Spree in Berlin.

**Electric Engineering in Paris.**—Messrs. Barnard and Elison will shortly enter into business in Paris as engineers and electric light contractors, and it is understood that Mr. Edward James Mason is to be appointed their managing engineer.

**The Finsbury Special Courses.**—Professor Thompson's lectures on electric bells at the City and Guilds' College, Finsbury, are now concluded. They are to be succeeded by a second special course on electro-plating. The lectures on bells will be repeated next autumn, if, indeed, they are not incorporated as a regular part of the instruction at the Finsbury College. The unique arrangement of having two hours of thoroughly practical laboratory work to accompany every lecture, stamps these "special" courses at Finsbury with a peculiar value. Amongst the exercises of the electric bell course, students have had not only to test insulation and resistance of lines, electromotive forces of cells, and strength of current required to ring various kinds of bells; but also to measure the force exerted by electro-magnets wound in different ways, and having cores of different brands of iron, when excited by different strengths of current. They have had to fit up several kinds of circuits with appropriate indicators for a three-roomed house, for a four-roomed house, for a hotel with two floors with separate indicators, and also circuits for "correspondence" between the two ends, and circuits worked with relays and by magneto bells. The laboratory course to accompany the lectures on electro-plating includes instruction in management of dynamos and of batteries, the preparation and testing of the various baths and solutions, the making of moulds, the verifying of the simple laws of electrolysis and of electro-chemical action, and the use of galvanometers in plating. The lectures on electro-plating are given on Thursdays, commencing November 18th.

**Electric Launches.**—M. Trouvé's electric launch, says the *Bulletin International de l'Electricité*, attracts much public attention, and visitors are astonished to see it upon so small a piece of water as that at the Palais de l'Industrie. The arrangement of the rudder seems to us worth description, as it allows of turning with the greatest facility. At the commencement of his researches, M. Trouvé fixed the propeller upon a false fixed rudder behind the usual rudder; but the boat answered very slowly to the rudder. He then placed the propeller upon a rigid rudder occupying the place of the regular one which was fixed behind it, but this did not give very good results. His last arrangement has remedied all these inconveniences. It possesses besides the advantage of being completely removable: any launch whatever can be provided with it, and can, if necessary, be restored to its original equipage, oars or sails. In this system the screw is fixed below the motor upon the rudder itself, and the course is changed more readily than with an ordinary rudder, as the angle of the propeller is altered with every movement of the tiller. The chains which move the rudder constitute the conductors connecting the battery and motor; they are formed of flexible metallic ropes, covered several times with silk and cotton, and lastly with an India-rubber tube, in order to protect it completely from accidents and moisture. These conductors are connected with a switch for stopping and starting the boat. After long researches, M. Trouvé has adopted, for the transmission from the motor to the propeller, the Vaucanson chain, or preferably the Galle chain. With these lubrication is not necessary, there is no danger from branches, plants, or sand, and any accident can be repaired on the spot. This rudder can be readily removed from the boat, and is consequently free from all danger of accident. The forward and backward motion is controlled by a lever which actuates an ingenious commutator, so arranged that when the lever stands perpendicular the boat remains at rest, lowering it towards the bow produces a forward, towards the stern a backward movement of the boat. This propelling rudder gives a perfectly practical solution to the question of pleasure navigation, as it requires no modification to existing craft. Launches provided with this apparatus can turn around their centre, as does that at the Exhibition.

**American Society of Mechanical Engineers.**—We have received the seventh volume of the transactions of this Society, among the contents of which are:—"Rapid Transit and Elevated Railroads, by F. E. Galloupe; "The Frictional Resistance of Shafting in Engineering Establishments," by Samuel Webber; "Experiments on the Transmission of Power by Gearing," by Wilfred Lewis; "Steam Engine Tests at Mass. Inst. Tech.," by C. H. Peabody; "Transmission of Power by Belting," by Gastano Langa; "Another New Steam Engine Indicator," by C. W. Barnaby; and "Experiments on the Transmission of Power by Belting," by Wilfred Lewis.

**The Value of Torpedoes.**—A correspondent writes:—The recent experiments with torpedoes against the old ironclad frigate *Resistance* in Fareham Creek have excited the liveliest interest in naval circles, and are regarded as by far the most important series that have been carried out for many years past. In some quarters, however, an entirely wrong conception appears to prevail as to the result of the last test, when a Whitehead torpedo of the almost obsolete sixteen-inch pattern, but containing a charge of gun cotton (93 lbs.) as powerful as that placed in the largest of the new types, was secured just under the bilges of the vessel on the port side amidships, and in precisely the same position as though it had just struck the ship. Among those entirely ignorant of the wonderful and deadly machines which the Royal Navy has at its disposal, an idea has always existed that if a torpedo comes into actual contact with a vessel, however heavily armoured, the ill-fated bark must necessarily be blown into the air. The editor of a certain service paper evidently enjoyed the same opinion, and hence when he hears that the old *Resistance*, though quite a veteran of the armoured class, her plates only being of 3½ inches thickness, was neither blown into the air, nor sunk on an explosion taking place right under her bottom, he arrives at the very erudite conclusion that torpedoes as engines of destruction have been greatly over-estimated, and that when an actual test takes place their value will be practically *nil*. No doubt many improvements might be made in the torpedoes at present used in the Navy, but the assumption that the

*Resistance* escaped with little hurt is entirely an erroneous one. As a matter of fact, the armour plate against which the explosion took place was perforated into a number of holes, and havoc was wrought in all directions. The compartment amidships was quickly filled by the inrush of water, which, owing to the widespread damage, made its way into the engine room at the rate of eight inches an hour. Damage was done to the coal bunkers, the contents of which were scattered, and there can be little doubt that had the ship been in actual conflict confusion must have reigned supreme, owing to the destruction occasioned below. The vessel has been docked in Portsmouth Dockyard, but after the lapse of several days it is almost impossible to estimate the whole extent of the damage, and it is clear that she will require a good deal of patching up before she can undergo any further experiments. It is certain that the torpedo, whatever may be said to the contrary by *soi-disant* naval critics, is destined to play a most important part in the sea warfare of the future. In its management electricity takes a very prominent part, and an interest might well be taken by inventors of an electrical bent in bringing this deadly instrument of warfare to a higher state of perfection.

**Presentation.** — Messrs. Drake and Gorham were requested to attend a meeting of the employés of the E.P.S. Company last week, at which the men presented them with two handsome clocks as a token of their esteem, and expressed their appreciation of the improved state of trade during the past two years.

**The Blackpool Tramway.** — A party consisting of Mr. T. Shaw, M.P., Colonel Maude, V.C., C.B., Mr. W. Ward, and others, visited Blackpool a few days ago with the view of ascertaining the prospects of a company which it is proposed to form to acquire and develop Mr. Holroyd Smith's English patents.

**Incandescent Lamp Patents.**—The meeting held at the Cannon Street Hotel on Monday last for the purpose of forming a combination of all those interested in the incandescent lamp question, unanimously carried the following resolution :—"That this meeting, as representing the electrical trade, is of opinion that the appeals against the decision of Mr. Justice Butt in the two actions brought against Messrs. Woodhouse and Rawson by the Edison-Swan Company should be carried on with the support of the trade and general public, and all persons interested should be asked to subscribe towards the fund to be formed to meet the necessary expenses." The following were appointed a committee to co-operate with Messrs. Woodhouse and Rawson on behalf of the trade :—Mr. Bernard Drake, late of the Electrical Power Storage Company ; General Webber, of the Anglo-American Brush Company ; Mr. Baily, of Mark Baily & Co. ; Mr. Swinburne, of Messrs. Crompton & Co. ; Mr. Offor, late of the Consolidated Brush Companies ; and Sir Rawson W. Rawson, of the Pilsen Company. As country members of the committee, and with power to form sub-committees, the following were appointed :—Mr. Wilson Hartnell, of Leeds ; Mr. J. C. Howell, of Llanelly ; Messrs. Walker and Olliver, of Cardiff ; Messrs. D. P. Menzies & Co., and Messrs. Henry Bennett & Co., of Glasgow ; Messrs. Holmes and Vaudrey, of Liverpool ; Messrs. Holmes and Co., and Messrs. Clarke, Chapman & Co., of Newcastle and district ; Messrs. Chamberlain and Hookham, of Birmingham ; the Crossley Telephone Company, of Bradford (who, Colonel Harrison said, would be pleased to subscribe £50 to £100) ; and Messrs. Paris and Scott, of Norwich. Mr. Rawson's report of the promises of support he had received was very satisfactory. He said the Brush Company had agreed to subscribe £500 generally towards the expenses. Several engine makers would subscribe £50 a-piece if others did the same ; and cable makers had made similar promises. Among the small electric light contractors several had put down their names for sums between £25 and £50.

[We think it right to say that the statement in the private report of the proceedings issued by Messrs. Woodhouse and Rawson, to the effect that the meeting was called by the editors of the ELECTRICAL REVIEW, is incorrect. We simply announced, as an item of news, upon information supplied to us by Messrs. Woodhouse and Rawson, that the meeting was to be held.—EDS. ELEC. REV.]

**The Marchant Engine.**—We have received three copies of letters addressed by Mr. Marchant to our engineering contemporaries, another from Mr. Downie, evidently inspired by the results of Wednesday, and a communication to ourselves from Mr. Massey. Taking into consideration the result of Wednesday's trial of the engine, the results of which we publish in this issue of the REVIEW, we think it useless to bring these letters before the notice of our readers. Our thanks are due primarily to Mr. Massey, and only in a slightly less degree to our contemporaries, for taking up the subject in such a manner as to leave Mr. Marchant no option but that of handing over the engine to us unreservedly in response to our letter of November 6th, which we append :—

R. M. MARCHANT, Esq.

Dear Sir,—In reply to your two letters dated November 5th, we have to say that if we cannot make a further trial of the engine without the blocks, E and F, we must feel that the adverse statements which have been made will have a prejudicial effect. In justice to yourself and to us, we would strongly urge the desirability of your compliance with our request, more especially since the letters of Messrs. Garrett and Hollick have appeared in *Engineering*. We, through Mr. Downie, in ours of the 3rd inst., have already asked you to arrange a run of the engine on Tuesday next, but owing to the Lord Mayor's procession seriously interfering with business on that day, we now suggest Wednesday in preference.

We particularly desire to settle the question at issue previous to our next number of the ELECTCICAL REVIEW, and we shall be quite prepared to run the engine safely without the assistance of the blocks, E and F, and to allow fully for the brake weight of 720 lbs. on the axle of the flywheel. Should you not grant our request, only one construction will be placed on your hesitation.

We are, Dear Sir, yours faithfully,
H. ALABASTER, GATEHOUSE & CO.

Although we must bear the chagrin of having shown the data compiled by our representative to be erroneous, we still have the satisfaction of being the main cause of sounding what will probably prove to be the death knell of the Marchant engine.

**Brighton Electric Railway.**—The serious damage inflicted on this railway by the recent storm has now been repaired, and the cars have commenced running the whole length of the journey. Particular care has been taken to strengthen the supports of the railway by substantial timber piles, which are also driven into the road at intervals in order to keep the road in position should the shingle be displaced in future on the beach. Mr. Volk's station near the Aquarium has been moved eastward nearly 30 yards, the pile being "shifted" in American fashion *en bloc*. The supports were cut asunder and the pile having been raised on rails and rollers was drawn along by means of chain tackle without even a pane of glass being broken. Letters of a sympathetic character have been received by Mr. Volk from all parts of the country. In spite, however, of his recent misfortune as much enterprise as ever is being exhibited in the conduct of the railway.

**Electro-Motors and Generators.**—Writing to *Industries*, Mr. W. B. Esson, whose article we last week republished, makes the following correction :—"In my article in your issue for October 22nd, there has been omitted a parenthetical clause regarding self-induction, which would alter, to some extent, the meaning. It is stated that $V_1 + CR = V_2 - CR$, and then afterwards that the latter quantity should always be somewhat greater than the former, two statements at variance with each other. The sentence in which the former statement is made should actually read 'then (*neglecting the effect of self-induction*) $V_1 + CR = V_2 - CR$,' the parenthetical clause referred to being that within the brackets."

## NEW COMPANY REGISTERED.

**Patent Electric Fire Lighter Company, Limited.**—Capital £3,000 in £1 shares. Objects: To purchase from Frederick Edenborough, of 14, Lansdowne Road, Tottenham, an invention, called the Electric Fire Lighter, in respect of which letters patent have been applied for. The applications and provisional specification are numbered 12,303, and dated September 28th, 1886. Signatories (with one share each): Hy. Stevenson, 7, Maltock Villas, Hoe Street, Walthamstow; E. Smith, 3, Oakhurst Grove, East Dulwich; T. Twine, 6, Ashville Terrace, Ashville Road, Leytonstone; John Lindsay, 37, Camden Road; B. C. Beamen, 22, Royal Exchange; H. M. Morgan, 42, Osborne Road, Finsbury Park; A. Powles, 2, St. John's Villas, East Dulwich. Registered 3rd inst., without Articles of Association, by J. A. Bartram, 11, Old Jewry Chambers.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Singapore, Straits Settlement, and Siam General Electric Company, Limited.**—An agreement, dated 29th ult., has been entered into with Mr. Edward John Wells, of 5, Trewsbury Road, Sydenham, for the sale to this company of certain concessions and contracts for £12,000, payable £6,000 in cash and £6,000 in fully-paid shares. These payments are conditional upon the vendor making out to the satisfaction of the company or its agents, a good title to the said concessions and contracts free from incumbrances.

**Electric Apparatus Company, Limited.**—An agreement, dated 1st inst. and filed on the 8th inst., stipulates that Mr. Gustav Binswanger shall cease to be a director of the company, and also cancels the allotments of 250 vendors' shares made to him, and provides for the removal of his name from the register of members. In lieu of the shares referred to, the company will allot Mr. Binswanger 25 fully-paid ordinary shares.

**Ryland's Electro-Plating Company, Limited.**—The annual return of this company, made up to August 19th, was filed on the 8th inst. The nominal capital is £20,000 in £10 shares. 1,910 shares are taken up, and upon these £4 per share has been called, the total of calls paid amounting to £7,640.

## CITY NOTES, REPORTS, MEETINGS, &c.

### Brazilian Submarine Telegraph Company, Limited.

THE twenty-sixth ordinary general meeting of this company was held on Thursday, November 4th, at Winchester House, Old Broad Street, the Right Hon. Viscount Monck presiding.

Mr. R. Collett, the Secretary, having read the notice convening the meeting, and the report, which was published in the REVIEW for October 29th, having been taken as read,

The Chairman, in proposing its adoption, reminded the shareholders that the last time he addressed them he was compelled to say that the depression of trade which had prevailed for so many years, and which for a long time seemed to have spared the company, had affected them in the way of receipts. The difference between the receipts for the quarter ended on the 30th of June this year and the 30th of June, 1885, amounted to a decrease of between £5,000 and £6,000; and he was bound to say that if it had not been for the improvement in the exchange as between this country and Brazil their loss would have been considerably larger. However, he was glad to say that they seemed to have touched bottom, because there had been a considerable increase in their receipts in the present half year, as far as they had gone, though they had reduced their tariff from 9s. to 7s. At the same time, they must not shut their eyes to the fact that though in many departments of trade they might notice an improvement, yet they could not assert positively that the depression which had so long prevailed had ceased to exist. They might, however, trust that they were turning the corner, and that their business, as well as other departments of trade, would be affected by the result. He told them at the last meeting that they were carrying on negotiations with a view to improving their position in Brazil. He asked them at that time not to call upon him to state explicitly what the nature of those negotiations was, or how far they had gone. The shareholders kindly acceded to his request, and he was sorry to say that he must still make a draft on their confidence and forbearance. It would not be for the interests of the company that he should state at present the position of the negotiations, which, however, they hoped to bring to a successful issue. With reference to the accounts, he did not think there was anything that called for observation. The general expenses were £198 less than those of the corresponding period of last year—a fact showing that, as far as possible, the directors were consulting economy in the management of the company's affairs. This reduction was also contemporaneous with a considerable expenditure on the renewal of houses and plant of different kinds at some of the stations. He then moved the adoption of the report and the declaration of a dividend of 3s. per share, making, with the interim dividend already paid, a total dividend of 6 per cent. for the year.

Sir James Anderson seconded the motion.

Mr. W. Griffith asked what profit the company were likely to make from their investment in the African Direct Telegraph Company. The balance sheet, though it spoke creditably for the efforts made by the directors, was not one which, in his opinion, gave the shareholders much encouragement for the future; and he found from official sources that, notwithstanding the great efforts of the Brazilian Government to foster private enterprise, they had had a woeful falling off in trade, and deficits for the last ten years. Though there did not seem much hope at present, it was possible that they might have something beneficial from their large investment in the company mentioned.

The Chairman, in reply, stated that the African Direct Company's cables had only just been opened, and it would be very imprudent, therefore, for him to pronounce either for or against a very great traffic on that cable. Moreover, he was informed that that was just the time of the year when European people were away for their holidays, and when trade was more or less suspended. They hoped, however, that the cable might be made profitable, and he had no doubt that it would after a while.

The motion was then carried unanimously.

The retiring directors, Dr. Taylor and Mr. Frederick Youle, were re-elected, as also were the auditors, Mr. Henry Dever and Mr. John Gane.

A vote of thanks was accorded the directors, and the meeting then terminated.

### The Brighton Electric Light Company, Limited.

FOLLOWING is the report of this company's operations for the twelve months ended 30th September:—

The profit and loss account shows a balance of profit for the twelve months of £516 16s. 5d., and the directors recommend the following appropriation of this sum:—

| | | | |
|---|---|---|---|
| Dividend of 4 per cent. on the share capital ... | £289 | 12 | 0 |
| Written off for depreciation of plant ... ... | 200 | 0 | 0 |
| Written off against preliminary expenses ... | 20 | 0 | 0 |
| Carried forward to next year's profit and loss account ... ... ... ... ... ... | 7 | 4 | 5 |
| | £516 | 16 | 5 |

The company was registered on the 14th December, 1885; the electric lighting business being taken over as from the 1st October, 1885. The statutory meeting was held on the 15th March, 1886.

Mr. Arthur Wright, who, while in the employ of the Hammond Electric Light and Power Supply Company, Limited, started the works at Brighton in conjunction with Mr. Hammond, and who has brought them to their present state of efficiency, was appointed managing-director; and the thanks of the shareholders are due to him for the satisfactory and economical manner in which he has conducted the business of the company during the past year.

There has been a steady increase in the company's business during the year, and the mains belonging to the company now extend over a distance of *eleven miles*; reaching westward as far as Queen's Gardens, Hove; eastward as far as Eastern Terrace, Kemp Town; and northward as far as Hanover Crescent, Lewes Road.

The number of lights supplied from the company's mains on the 1st October, 1885, was 34 arc lights and 516 incandescent lights, and the number at present supplied is 27 arc lights and 875 incandescent lights, the following being the list of the present installations: The London Brighton and South Coast Railway Terminus; the Orleans Club; the Grand Hotel; the Chapel Royal; Sir Albert Sassoon, Eastern Terrace; Reuben Sassoon, Esq., Queen's Gardens, Hove; Arthur Sassoon, Esq., King's Gardens, Hove; Panmure Gordon, Esq., Adelaide Crescent; F. Shoolbred, Esq., Marine Parade; the Brighton Aquarium; the Co-Operative Drug Store Company; the Oxford Music Hall; the Bankrupt Stock Agency, North Street; the Fifth Avenue Hotel; the Gloucester Hotel; the Phœnix Brewery; Dudley Mansion; Connaught House; Haslemere House; W. C. Tamplin, Esq.; G. Attree, sen., Esq.; G. F. Attree, Esq.; Messrs. Wells & Co., tea dealers; Mr. Lediard's Bazaar; Messrs. Hannington and Sons, silk mercers; Mr. H. S. Soper's Emporium; Messrs. Hudson Brothers; Mr. Attree's offices; Mr. Ullman; Messrs. Hart & Co.; Messrs. Lewis and Son; Mr. Milner's tea stores; Messrs. Lawson and

Sons; Dr. Carter; Mr. Austen's drapery stores; Mr. Harry Saunders; Mr. Lawrence's supply stores; Mr. Kemp; Mr. Farmer; Mr. Green's dining rooms.

It will be seen that, with the large extent of the company's mains, and the comparatively few lights that are at work, a great increase of the company's business is possible, and this increase appears likely to immediately accrue in face of the many demands which the company is having for new lighting for the approaching winter; demands which it is unable to satisfy with its present plant.

The directors have therefore decided to double their engine and dynamo power, and to do this an expenditure of about £2,000 is necessary. This extension of the plant will bring the lighting power of the station up to 2,000 incandescent lights.

To provide for this sum, the directors have decided to call up the 10s. per share remaining unpaid upon the 1,600 shares of the company, which will produce £800, and so make the whole of the shares of the company £5 paid.

To raise the balance of £1,200, the directors propose to issue 240 new fully-paid £5 shares, and they now beg to offer these shares to the present shareholders in proportion to their present holdings, but should applications for these shares be received from residents in Brighton and Hove, preference will be given to them, in order to widen the local interest in the concern.

The directors feel confident that, by the expenditure of the above-named £2,000 they will be able during the course of the current year to double their gross receipts, and as the expenses will not be augmented in the same proportion, a substantial increase in the net profits of the company will in their opinion result.

## The West India and Panama Telegraph Company, Limited.

The report of the directors states, that the amount to credit of revenue is £45,434 18s. 7d., and the expenses have been £26,686 5s. 10d., leaving a balance of £18,748 12s. 9d., which, with the balance of £4,369 4s. 3d., brought from last account, makes a total of £23,117 17s. 0d. Of this sum the directors have placed £7,000 to reserve, leaving an available balance of £16,117 17s. 0d. with which it is proposed to deal as follows:—

| | £ | s. | d. |
|---|---|---|---|
| Payment of 8s. per share on account of arrears of dividend on first preference shares ... ... ... ... ... | 13,825 | 4 | 0 |
| Balance to current half-year's account ... | 2,292 | 13 | 0 |
| | £16,117 | 17 | 0 |

The traffic receipts show a decrease of £5,039 11s. 9d., as compared with the corresponding period of 1885, attributable to the depressed condition of the West Indian trade.

The company's ss. *Grappler* has been engaged in repairing the duplicate Jamaica-Porto Rico section. Owing to the great depth for many miles on each side of the break, which is in 2,400 fathoms, the board decided, in executing the repairs, to lay the new cable required in much shallower water. After laying in 120 knots of new cable, the *Grappler* was compelled to discontinue operations in order to proceed to the repair of the Jamaica-Colon section, one break in which has been already made good. She is now engaged upon another interruption midway between Jamaica and Colon.

A contract has been entered into with W. T. Henley's Telegraph Works Company for the manufacture of 250 knots of deep sea cable to replenish the stock in the West Indies. For the purpose of taking out this cable the ss. *Grappler* will shortly return to London.

The Government of British Guiana have not acceded to the company's proposal for laying a new cable between Demerara and Trinidad. The board are still in communication with the Colony on the subject. The Colonies of British Guiana, St. Kitts, Antigua, and Dominica have renewed their subsidies for a further term of one year.

With reference to the proposal of H.M. Government to lay a cable between Halifax, Bermuda, and Jamaica, the directors have satisfaction in announcing that they have been informed by the Secretary of State for the Colonies that, for the present, it has been decided to call for tenders for a cable between Halifax and Bermuda only.

**United Telephone Company, Limited.**—The directors announce an interim dividend of 5s. per fully paid share, less income tax, part paid shares receiving in proportion. The transfer books will be closed from the 13th to the 26th inst. inclusive, and the dividend warrants will be posted on the 26th inst.

## TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 5th were £2,924 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Great Northern Telegraph Company, Limited. The receipts for October, 1886, were £22,240; from January 1st to 31st October, 1886, £217,800; in the corresponding months, 1885, £241,640; and of 1884, £234,680.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending October 31st, were £4,825.

## NEW PATENTS—1886.

13842. "Producing electricity by employing the rotary action for axles of cars or carriages and applying same for charging accumulators for carriage lighting, braking the train, &c." J. Mettlik. Dated October 28.

13889. "Incandescent electric lamps." A. P. Laurie. Dated October 29.

13908. "Transmitting sounds by means of electricity." C. Pollak, G. Binswanger. Dated October 29.

13971. "Self-regulating electric portable battery and lamp." H. R. Fisher. Dated October 30.

13910. "Producing electricity; apparatus therefor." G. Quarrie. Dated October 29.

13974. "Electric telephony." J. G. Lorrain. Dated October 30.

13975. "Electric alarm clocks." R. Eras. Dated October 30.

13978. "Coupling two or more alternate current dynamo electric machines with a main circuit and apparatus therefor." C. D. Abel. (Communicated by Siemens and Halske.) Dated October 30.

13987. "Collector or brush for dynamo or magneto-electric machines or motors." J. G. Statter, S. L. Brunton, J. W. Kempster. Dated October 30.

13989. "Electric motor." J. B. Denis. Dated October 30.

14002. "Self-acting electro-magnetic combined switch and cut-out." J. M. V. Kent. Dated November 1.

14003. "Electric safety lamps." W. Banks, S. Brierley. Dated November 1.

14026. "Electric arc lamps." Hon. C. A. Parsons. Dated November 1.

14033. "Electrolysis." C. D. Abel. (Communicated by Siemens and Halske.) Dated November 1.

14045. "Electric bells and indicators." W. P. Granville. Dated November 1.

14075. "Electric lamps." R. E. Phillips. (Communicated by W. T. Hill.) Dated November 2.

14098. "Electric signalling between trains, and between trains and stations, &c." O. Hughes. Dated November 2. (*Complete.*)

14104. "Frictional gearing for driving dynamo-electrical machines." A. B. Holmes, J. C. Vaudrey. Dated November 2.

14105. "Automatic electric signalling for railways, and apparatus therefor." W. Walker. Dated November 2. (*Complete.*)

14106. "Conducting electricity to moving vehicles." C. Pollak, G. Binswanger. Dated November 2.

14140. "Electric systems for communicating between two or more positions in navigable vessels, &c." W. Chadburn. Dated November 3.

14249. "Electrical fuses." G. Smith. Dated November 5.

14263. "Making metallic covering for telegraph and telephone cables." A. Wylie. Dated November 5.

14269. "Galvanometers." R. E. B. Crompton. Dated November 5.

14280. "Voltaic batteries." W. H. Tasker, T. J. Jones. Dated November 5.

14281. "Electro-plating and coating metallic surfaces." R. K. Boyle. Dated November 5,

14286. "Galvanic battery." A. Wanderlich. Dated November 5.

14293. "Effecting telephonic exchanges." W. B. Avery. Dated November 5.

14314. "System of electrical communication on passenger trains, for replacing the communication cord, and effecting other services." J. Holland. Dated November 6.

14336. "Facilitating the sending of telegrams." W. B. Avery. Dated November 6.

14345. "Electrodes for accumulators or secondary batteries." H. Tudor. Dated November 6.

14352. "Armatures for dynamo-electric machines and electromotors." J. Wodicka. Dated November 6. (*Complete.*)

14398. "Dynamo machines." L. Bollmann. Dated November 8.

14408. "Solutions for use in the electro-deposition of aluminium and substances for use in preparing such solutions." O. M. Thowless. Dated November 8.

14409. "Electric fire and burglar alarm apparatus." S. Taussig. Dated November 8.

14489. "Lighting railway carriages and tramcars by electricity." C. Smith. Dated November 9.

14510. "Electric arc lamps." W. J. Mackenzie. Dated November 10.

14534. "Dynamo-electric or magneto-electric machines." J. J. C. Rappard.

14552. "Preventing induction on telephonic and telegraphic lines (phono-electrographe). L. Kelner. Dated November 10.

14563. "Secondary batteries." J. S. Sellon. Dated November 10.

## ABSTRACTS
## OF PUBLISHED SPECIFICATIONS, 1885.

11615. "Improvements in instruments for measuring and controlling electrical currents." J. H. Davies. Dated September 29. 11d. Consists essentially of two or more pieces of magnetic material freely sliding, or moving, or revolving on a common support or axis, and which are so placed, in magnetic fields or in parts of the same magnetic field, as to tend to move the said support or axis in opposite directions of movement, but which do not equally increase or decrease in their induced magnetism with an increase or decrease in the strength of the magnetic field acting upon them. By the respective positions they are caused to occupy by the said variations in their induced differential force, they indicate corresponding variations in the strength of the magnetic field or fields, and consequently of the current or currents producing them; and further, at any chosen limits of such indications, my device may effect electrical contacts, which may be utilised in a variety of known ways, to regulate or control electrical currents. The claims are 9 in number.

11876. "Improvements in the manufacture of carbon filaments for electric lighting." T. V. Hughes and C. Rowland. Dated October 6. 8d. Consists in a process of destructive distillation of a carbon compound in the gaseous or liquid form during its ejection under pressure through a suitable nozzle or orifice into a chamber containing an atmosphere incapable of combining with the carbon of the compound, which is condensed in the form of a filament, the temperature of this atmosphere being sufficient to produce the decomposition of the carbon gas or liquid.

12681. "Improvements in arc lamps." J. Brockie and B. Pell. Dated October 22. 8d. Claim:—In arc electric lamps having a solenoid coil in the lamp circuit, the core of which when attracted, acts on clutch mechanism so as to separate the carbons, and having also a solenoid coil in a by-pass circuit, arranging the cores of these coils in relation to the clutch mechanism so that when that of the former has acted independently in separating the carbons, the core of the by-pass coil opposes and influences its further movements, substantially as and for the purpose set forth.

13015. "Improvements in means for suspending electric lamps." T. B. Wilson. Dated October 29. 8d. The inventor suspends the lamp by means of a combination of parts jointed together on the lazy tongs principle, and employs in addition a suitable conductor to convey the electric fluid, or he makes provision at the outer joints, or at some of them, for the maintenance of suitable metallic contact. The claims are 3 in number.

13416. "Improvements in automatic electrical switches." L. Clerc. Dated November 5. 8d. The apparatus is usually made to carry two lamps, one of them being on the same circuit as a small coil or solenoid. On the circuit of the other is a cut-out of any convenient form, but worked by the coil. When the current first flows in the circuit it passes for an instant through both lamps, when the coil being acted upon, works the cut out, and one of the lamps is switched out of the circuit. Should the filament of the first lamp break, the current is automatically switched into the other, and lights the same; thus avoiding darkness and accidents. The apparatus may be applied to groups of incandescent lamps, or to two arc lamps. For incandescent lamps the apparatus is usually constructed with a small solenoid or coil, enclosing a very light iron core having two points, which points are capable of dipping into two cups containing mercury, and thus closing a circuit to which a lamp is connected by one of its poles. The other lamp is in like manner connected by one of its poles to the coil or solenoid circuit, and by the other poles the lamps are connected to each other. The two small cups containing the mercury are closed by two cones of wood, or any suitable material, so formed that when moved or inverted, the mercury is not liable to fall out; and the two very fine holes are bored in the conical caps to allow of the points of the iron core to pass through without friction, and thus to close the circuit. A connection is made to one of the mercury cups, one of the lamps being connected to the other (as previously stated), the action being to automatically switch the current from the first lamp, when the filament breaks, to the other, as described already. Claims:—1. An automatic electric switch, operating substantially as and for the purpose described. 2. The combination of two mercury cups, a magnetic core and solenoid, substantially as and for the purpose described. 3. A base of non-conducting material, arranged to carry two or more lamps, or groups of lamps, or to supply current thereto, arranged on circuit automatically operating through the intervention of a solenoid and two mercury cups, substantially as and for the purpose described.

13478. "Improvements in electrical switch boards, or apparatus for connecting sources of electricity, such as dynamos, with electrical circuits." R. A. Scott, W. T. Goolden, and A. Pelham Trotter. Dated November 6. 8d. Claims:—1. A switch board comprising a series of bars, each of which is one terminal of a dynamo, and a series of levers each of which is one terminal of a circuit, the said levers being over and at right angles to the said bars, and each lever being provided with a sliding contact piece, and being arranged in such a manner that when liberated from the locking device it rises automatically to such a distance that not only is the circuit broken between the sliding piece and the bar, but the two are so far removed that it is not possible for an arc to be established between them, substantially as described. 2. In a switch board, providing an automatic locking device which, on the contact piece being pressed into position secures it there, substantially as described. 3. In a switch board the use of a double set of safety fuses in each circuit, substantially as hereinabove described for the purpose specified. 4. The hereinabove described switch board.

13543. "The application or employment of the electric-search-light to a gun or cannon." I. K. Rogers. Dated November 7. 6d. The object of this invention is to so fit or arrange a search-light to the frame of a gun or cannon, or to a gun or to a cannon itself, in order that the line or direction of firing can be determined from the gun or cannon.

13696. "Improvements in telephonic systems." J. Stephen. Dated November 10. 8d. Relates to the apparatus described in the number of the Review for July 30th last. The claims are 5 in number.

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## 1886.

398. "Improvements in the method of supplying liquids and mixtures to electrical batteries." J. T. Armstrong. Dated Jan. 9. 8d. Claims:—1. In electrical batteries the application and use of a succession of exciting fluids, substantially as and for the purposes described. 2. In electrical batteries the application and use of fluids, or mixture of fluids in succession, severally selected and varied so as to neutralise objectionable effects arising from the action of antecedent fluids, and to restore the electrodes to more effective working, substantially as described. 3. The means described for increasing the uniformity and continuity of the electric force produced, substantially as described. 4. In electrical batteries, the method and means of filling and emptying the cells by raising and lowering the cisterns, such cisterns being fitted with plugs and levers, and which cisterns are partially or wholly balanced and guided by a framing, substantially as described and shown on the drawings. 5. In electrical batteries, the application and use of a cleansing cistern communicating with the cells of the batteries, for the purpose of cleansing the same and utilising the products arising from such cleansing process, substantially as described. 6. The manufacture and use of an improved apparatus for effecting the purposes aforesaid, or some one or more of them, substantially as described and shown in the drawings. 7. The general construction, combination, and arrangement of the several and respective parts, or of some two or more of them respectively, together forming the improvements in the method of supplying liquid and mixtures to electrical batteries, substantially as described and shown on the drawings.

3540. "An improved electric fuse for blasting purposes." A. M. Clark. (Communicated from abroad by La Société Scola et Ruggieri, electricians, of Paris.) Dated March 12. 8d. Claim:—An electric lighting fuse or "lighter" for blasting purposes, denominated the Ruggieri fuse, consisting of a guide tube, grooved wood plug, conducting wires, fulminate and quick match, the grooved plug and conducting wires being enclosed in a paper or other sheath or cap to contain the fulminate, and the whole being enclosed within the tube, substantially as shown and described.

6678. "Improvements in electric bell and house telephone apparatus and systems and telephonic appliances." C. Herz. Dated May 18. 11d. Claims:—1. The combination of a microphonic transmitter with a receiving telephone and a call button, forming the micro-telephone button, as set forth. 2. The annular contact of the fixed part and movable part of the micro-telephone button, as set forth. 3. The combination of a microphonic transmitter with a receiving telephone, a call button, and a commutator or switch, in a single fixed or movable device, substantially as described. 4. In a telephone the combination of a microphone transmitter with a receiving telephone, a call button, a call bell or other alarum, and a commutator or switch, in a single fixed or movable device, substantially as described. 5. The arrangement of the automatic microphone stations, and especially the employment of the telephone carrier commutator to hold the call buttons during the conversations, and to withdraw the numbers that have appeared at the indicator boards, as set forth. 6. The arrangement of the systems hereinbefore described, and especially those which allow of the employment of $n + 2$ wires with the micro-telephone buttons, and of $n\left(\frac{n-1}{2}\right) + 2$ wires with the automatic microphone stations. 7. Constructing or fitting commutators with two press keys or push buttons to open or close the primary and secondary circuits separately, substantially as described. 8. Arranging the telephone button so that parts can be put in connection, whereby the bell of the station which calls can be excluded and the use of a line wire saved. 9. A portable telephone apparatus comprising a microphone-magneto receiver and push button, substantially as described. 10. A portable telephone apparatus, consisting of a magneto-receiver, a microphonic transmitter arranged behind the same, a signalling push button, and suitable connections, substantially as described. 11. In a portable telephonic station apparatus, the combination of a microphone with a magneto receiver covering the same, and sound openings between the receiver and microphone, communicating with the latter, substantially as described. 12. A hand telephone consisting of a case containing a microphone receiver, push button and switch, in combination with an induction coil, also located within the case, substantially as described. 13. In a hand telephone, the combination of a microphone and a magneto receiver, with a push button or press-key for signalling projecting through the handle of the instrument, and another push button or key operating a switch within the case for closing and opening the microphone and line circuit, substantially as described.

## CORRESPONDENCE.

### The Marchant Engine.

We have received from Mr. Kempe the following copy of a letter to *Engineering* in reply to the criticisms of that journal upon his article published in our issue of October 29th.

[COPY.]

THE MARCHANT ENGINE.

*To the Editor of "Engineering."*

Sir,—With reference to your comments on my criticism, which appeared in the No. of the ELECTRICAL REVIEW for October 29th, you will, I trust, allow me to make a few remarks on the same.

You suggest that I should again read the article which I criticised. This I have done (more than once), and I cannot see reason to alter the opinion I have expressed if I am to take the words you have written in their literal and not their implied meaning. The whole gist of the matter, of course, lies in the probability of the pressure at the point, F, being a "following" one. Now, I particularly noticed in your article that there was no suggestion that such was the case; in fact, you very plainly state—"as the point, F, *is* (the italics are my own) a fixed one"—; in your reply in your last issue, however, you say,—"If on the other hand the bearing at, F, was very elastic, and that at the top of L, practically rigid, the resolved pressure, *p*, would be added to the existing strain at the top of L, the pressure on the points, F, being practically unaffected"—. This I readily admit, but I submit that my criticism was based on a supposition that this elasticity did not exist, and that by your statement, which I have before quoted, viz.,—"as the point, F, *is* a fixed one,"— you yourself assumed it so.

Messrs. Garrett and Hollick's letters certainly at first sight appear to "throw an entirely new light on the arrangement of the brake;" but I think, at the same time, in possible justice to Mr. Marchant, that a different interpretation *may* be put on the matter, and that the obvious inference which the above gentlemen hint at *may* be a mistaken one. A "Timmis" spring is, I believe, one in which a very slight movement is effected by a very strong pressure—in fact, the spring is not of the nature of a "following" one; if this is the case, it must be obvious that the fact of the point, E, being at a distance of 1 foot from the centre line of the brake, instead of being only a short distance removed from it (as was imagined), would cause a comparatively small angular movement of the brake, such as would occur when the latter moves under the influence of the rotating fly wheel, to at once remove the effects of the Timmis spring. The latter, I should imagine, was placed not for the purpose hinted at, but simply to act as a buffer.

Yours faithfully,

G.P.O., London. H. R. KEMPE.

### Magnetic Fields.

We observe a paragraph in your issue of November 5th, under the title of "Magnetic Fields," in which you allude to M. Marcel Deprez's claim that the particular construction of magnetic field with short and thick electro-magnets was first introduced by him in February, 1883, and that the example set by him had been followed in the reconstruction of the Edison dynamo. As this claim of priority is entirely without foundation, we ask you to note that the advantages of the altered form of the magnetic circuit was first experimentally demonstrated by Dr. John Hopkinson in the autumn of 1882, and that early in December of that year we received instructions from him for a dynamo with short and thick magnets, which we at once constructed and tested with most satisfactory results early in January, 1883; and that we actually delivered machines for commercial use in March, 1883. Since that time we have adhered to the configuration of magnetic field then introduced, without material alteration. The advantage of the new form was at once generally recognised, and has led to entire reconstruction, in this respect, of all modern types of dynamo-machines, not only in England, but in America and Germany, as also in France.

**Mather & Platt.**

### Insurance Companies and Electric Lighting.

I am sorry and surprised to see the letter, signed "Resistance," in your issue of the 5th. I think either that "Resistance" has not had any very wide experience in the erection of electric lighting installations, or else that he has written without any consideration.

I may safely say that none of the leading electrical firms and companies, for instance, the Brush Company, Messrs. Crompton & Co., the Edison Company, Siemens, Woodhouse & Rawson, have ever the slightest difficulty in getting their installations passed by the fire insurance officers, and I believe that they use and recommend the rules of the Phœnix Fire Office, which are now practically the rules adopted by all the insurance offices.

I believe that these rules have done an immense amount of good both to the public and electric light contractors, and I have never heard of a case in which they have done harm.

With regard to the size of the cables, I may say that in large electric light installations, those with whom I work always put in conductors larger than those that the Phœnix Fire Insurance rules compel, and our rule is to use nothing but the very best material, and do nothing but the very best work, leaving not the slightest opening, if we can help it, for an accident to occur.

I don't think that "Resistance" in his work could have come into contact with the leading fire insurance companies' officers. If he ever has a difficulty, his best method would be to write to some one like Mr. Musgrave Heaphy, who inspects for most of the London offices, and who would at once get the building insured if the work were satisfactorily done. I believe I am right in saying that when the Phœnix Fire Insurance Company's rules were compiled, they were shown beforehand to the leading electrical firms and passed by them. I certainly saw them, and I believe that various points were altered in accordance with the views expressed by some of those to whom they were shown. I may mention that these rules are not nearly so stringent as they are in many places abroad, where electric lighting is often much more hampered, not only by stringent rules, but in many cases by utterly absurd rules.

"Resistance" can have no idea of the amount of scandalously cheap and bad work that is being done in this country at the present time.

There is no doubt that this cheap and bad work will do great damage to electric lighting. Already I know, I may almost say, of many instances where fires have occurred through the same.

**Experientia.**

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At this time, when there is some risk of the good name of electric lighting suffering from the imperfect manner in which the wiring of several installations has been carried out, we much regret to see the letter signed "Resistance," suggesting that fire insurance rules for laying electric light wires, &c. (by which we conclude he means the Phœnix rules) are of too stringent a character.

We ourselves have carried out a large number of contracts under these rules, and have never had the slightest difficulty in getting our work passed by the fire office inspectors. We cannot understand why any contractor who intends to carry out his work in the best possible manner should object to the very wholesome check which these rules impose on cheap and dangerous wiring.

We know of a large quantity of wiring now being carried on in London of such a character that it is certain to be a source of trouble and even danger to the users of the installations. For obvious reasons we cannot give the names or places, but assuredly if fire or other trouble follows on such bad work it will affect us all indirectly, and we are concerned in preventing such work by all means in our power.

We do not for a moment pretend to say that the Phœnix rules are perfect, but they show an honest intention to insure good work by insisting on the use of well insulated conductors of ample capacity, and on reasonable precautions to prevent dangerous contacts, whether due to mechanical causes, or to the more subtle leaks arising from electrolytic action from damp plaster, wet floors, &c.

No doubt there are many men who call themselves electrical engineers who would be glad to staple a few miles of single cotton-covered wires under the floors of the London warehouses and get for such work a price slightly lower that that asked by honest contractors for laying the best insulated cables in casing. We, for our own part, are glad to see that the fire office rules are acting to same extent as a check on such practices.

**R. E. Crompton & Co.**

*November 9th*, 1886.

P.S.—The insulation resistance fixed for 200 volt installations is 10,000 ohms, not 100,000 ohms, as stated by your correspondent.

### Telephone Circuit for Speaking Condensers.

Allow me to express my opinion about the arrangement of Mr. Marshall in your last issue (p. 444). If $n$ and $n_1$ are the number of the turns of the coils, S and $S_1$, one of them can be omitted (at each station), if at the same time the number of turns of the remaining coils is made $n + n_1$, without in the least altering the quantitative or qualitative working of the system.

In that case, Mr. M.'s arrangement is identically the same with Prof. Dolbear's, of which it seems to me to be a modification without any practical or theoretical value.

**J. W. Giltay.**

*November 9th*, 1886.

### Dynamo Testing.

In my letter to the *Electrician* of September 24th, I wrote under the head of "Captain Cardew's method of testing the efficiency of dynamos," and proceeded to describe what I thought was "the most useful form of this excellent method."

I now learn that Captain Cardew has employed exactly the same plan, and has used not only three, but five machines. The system in its entirety is, therefore, undoubtedly his. I am not aware that it has been published; the only information I have had has been in conversation and correspondence with Captain Cardew. It should be noted that both he and we drive with belts, and that losses due to them are included in "commercial efficiency," as is right.

**A. P. Trotter.**

*November 8th*, 1886.

### Jarman's Electrical Tramcar.

Your article upon the trials of my model electrical tramcar published in the ELECTRICAL REVIEW of October 29th, is all well and good until you give your opinions upon those points with which you did not make yourselves thoroughly acquainted. The fact is my plan *does* give variable speed, but not with variable gearing. I hold that two sets of gearing is unnecessary, and in all instances with which I am acquainted it is not used. My plan for the transmission of power from the motor answers perfectly in the model. When upon an incline of 1 in 36, it starts with its load of iron weights just as well as upon a level. I am not responsible for the remarks of the *Standard* of October 26th about the unipolar motors, but I will back them up in their remarks about the two motors acting as an effectual brake, because I have completely stopped the model car when loaded and running at a speed of 154 feet in 30 seconds within the space of *six inches*. It is only a question of strength of material, and I will venture to do the same thing with the full-size car as soon as it is completed. When it is considered that this model has been worked out by myself in spare time, single-handed, that it is the outcome of previous practice with electro-motors and experience of their faults, that it was *perfect at the moment of production* and answers *all* the requirements for which it was designed, without modification or alteration, I do say that this speaks more for its soundness of principle than any criticism based upon a superficial inspection.

**A. J. Jarman.**

*November 6th*, 1886.

[It is evident that Mr. Jarman has taken our concluding remarks seriously, although they probably have not struck anyone else in the same light. The next best thing to gaining the good opinion of others is, we suppose, to have a good opinion of oneself, and in this respect Mr. Jarman is not deficient. However, both for his own sake and that of others working in the same direction, we trust that his perfected apparatus will be as successful as the model and that some tramway company may be induced to adopt the system.—EDS. ELEC. REV.]

### Re Incandescent Lamps.

Will you kindly insert our reply to Mr. Shippey's letter in your next issue.

**James & James.**

*November 4th*, 1886.

[COPY.]

23, Ely Place, London, E.C.,
*1st November*, 1886.

*Re Incandescent Lamps, re Crossley & Hicks, re Patent 2nd November, 1885, No. 13,201.*

Sir,—We are in receipt of your letter of the 27th ult., which has been laid before our clients, and we are now instructed to state in reply to your letter that we are prepared on our clients' behalf to accept service of any process which you may be advised to issue.

We are, Sir, yours faithfully,
JAMES & JAMES.

Arthur Shippey, Esq.

### Measurements in Alternating Current Circuits.

I have read with interest in your last issue an article by M. Hospitalier on the measurement of work done in an alternating current circuit. The following method has occurred to me for determining the difference of phase between the difference of potential and the current. Construct a phonograph with two mouthpieces, the diaphragms to be of thin sheet iron. A permanent or soft iron magnet is placed in front of each diaphragm. A single turn of the main cable is taken round one magnet. A few dozen turns of finer wire are coiled round the other magnet. One end of this coil is joined to one end of a double-wound coil of high resistance, and having no self-induction. The other two ends of the coil and resistance are joined to the points whose mean difference of potential is being measured by a Cardew voltmeter or an electro-meter. One of the diaphragms mentioned above will vibrate in unison with the changes of current; the other diaphragm with the changes of potential. These vibrations will be recorded by the rotating cylinder, and the difference of phase can be determined. I think the magnet coils might be made to have very little self-induction. If the alternations are not very rapid the difference of phase can be estimated by the ear, if two suitable telephones are employed.

**G. Bowron.**

*November 9th*, 1886.

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